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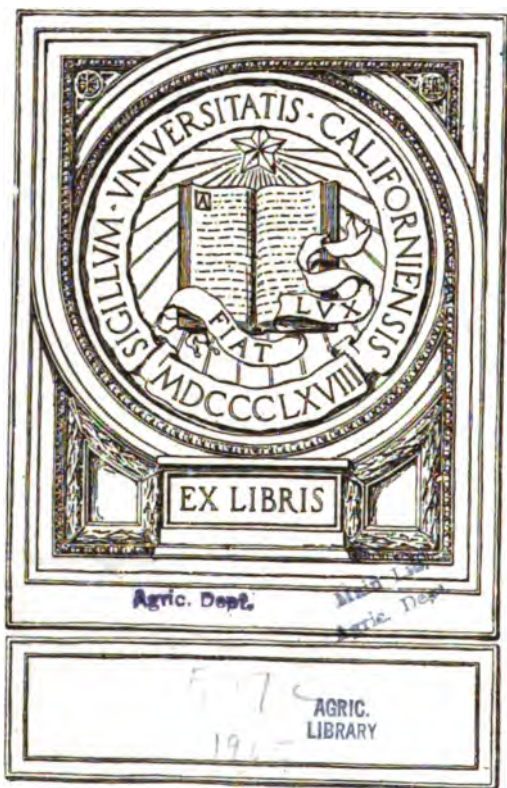
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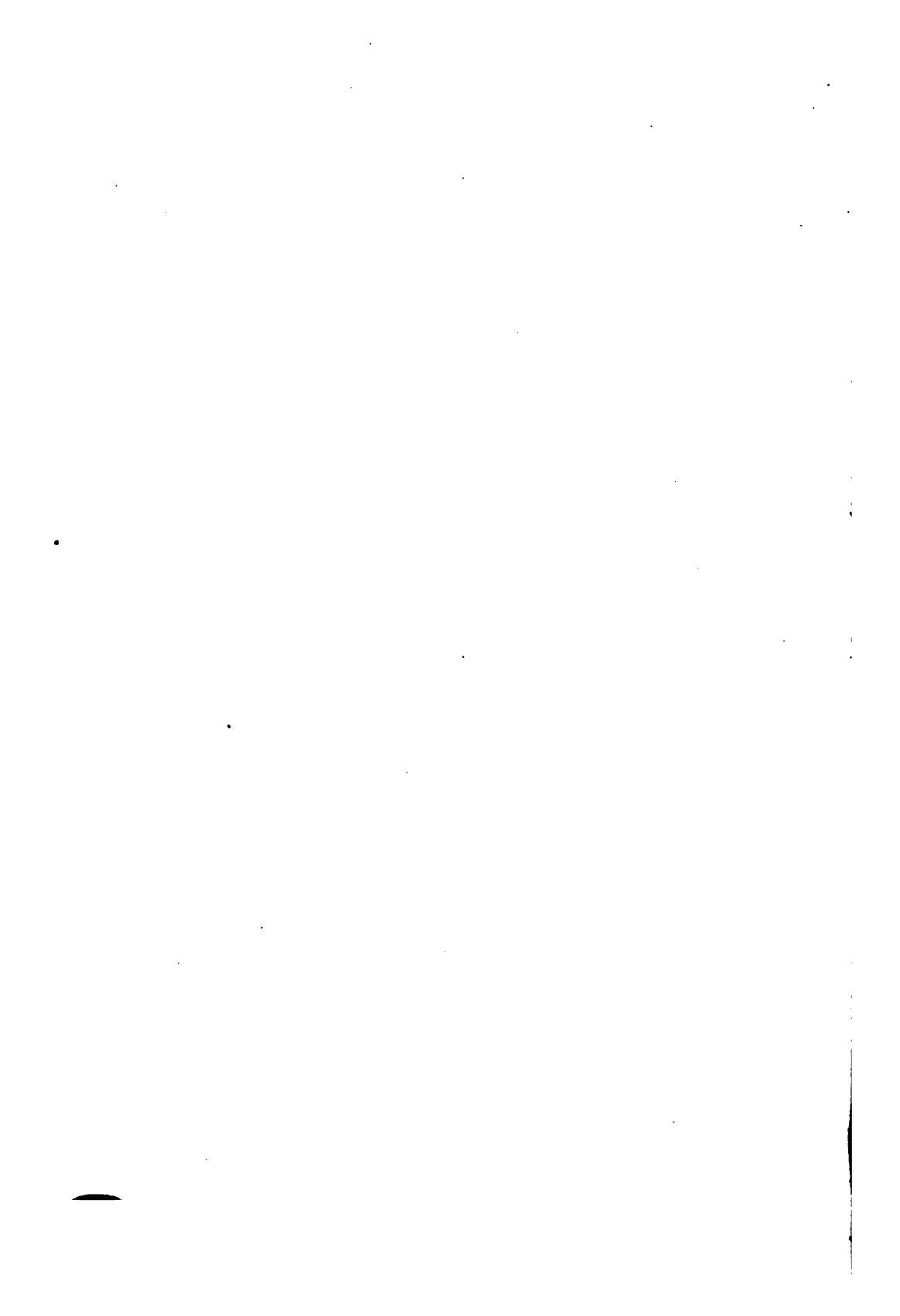
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STATE AGRICULTURAL COLLEGE

FORT COLLINS, COLORADO

Colorado Agricultural Experiment Station

1905
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Publications of 1905

The Agricultural Experiment Station

FORT COLLINS, COLORADO

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† From March 17, 1905.

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97. "Feeding Steers on Sugar Beet Pulp, Alfalfa Hay and Farm Grains".....Ey W. L. Carlyle, C. J. Griffith and A. J. Meyer
98. "Beet Worms and Their Remedies"—
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The Shade Trees of Denver.

— BY —

W. PADDOCK and B. O. LONGYEAR.

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THE SHADE TREES OF DENVER.

BY W. PADDOCK AND B. O. LONGYEAR.

A great many shade trees have been planted on the farms and in the towns in the agricultural sections of Colorado, but this does not necessarily mean that all who have planted trees did so because of their love of plant life. Perhaps a majority of the settlers formerly lived where trees grow to perfection and their absence here emphasized the fact that a house destitute of trees does not meet all the requirements of a home. Then, too, it is almost necessary to have some relief from the glare of the intense sunshine and from the monotony of the plains. So the settlers have not been slow to make the best of what the country affords and but few country homes are seen in the older agricultural sections that are not surrounded by groves of cottonwood or boxelders. Neither is it uncommon to see country roads bordered with these trees; and in the older towns and cities, shade trees are as common as in many states that are more favored in this respect. Associated as they are with the early development of the state, the cottonwood and boxelder will not soon be supplanted. Their principal virtues, however, lie in the fact that they are easily transplanted and under favorable conditions make rapid growth. They also withstand the extremes of drouth and moisture if not too long continued and do not readily break down during a windstorm or under a load of snow and sleet. But, unfortunately, the quick growth for which these trees are mostly esteemed, leads naturally to early maturity. Trees that were planted by the first settlers twenty-five and thirty years ago, are now mature, and, judging from appearances, it will be only a few years before most of them must be removed. Full grown specimens of either species are rarely beautiful, and the wood has little value from a commercial standpoint.

Still another cause has contributed in no small degree to the popularity of these trees. Large sums of money have been expended in the effort to introduce trees from the East, especially those kinds that were common about the old homes. But as the conditions that obtain in an arid climate were little understood, and a majority of the people who undertook to plant trees were not accustomed to the work, most of these efforts resulted in failure, since but few trees will stand abuse and neglect so well as the cotton-

wood and the boxelder. Is it any wonder then that the idea has been almost universal that trees foreign to the state will not succeed?

But in a large city like Denver, with its parks, cemeteries, avenues, and fine residences, fine trees are such a necessity that failures only stimulated the desire to overcome the obstacles. Repeated trials have resulted in many successes, and as a result there are growing in that city today at least 60 species and varieties of trees which are foreign to the state. Many of these trees occur as isolated specimens, and as they are scattered over a large area they have attracted but little attention. A majority of the residents of Denver will no doubt be surprised to learn of the large variety of trees in their city. Mr. W. G. M. Stone, President of the State Forestry Association, has given much attention to the trees of Denver for several years past, and we are indebted to him for all the data given in this bulletin. Mr. Stone read a paper at the convention of the Board of Horticulture in 1901 in which the following extract occurs: "Whatever trees are found to grow successfully in Denver would thrive at all other points in the state adapted to deciduous tree culture." Believing that this statement is true in the main, it is then desirable that all prospective tree planters should have the advantage of this experience. To be sure, a record of 25 or 30 years' growth is not conclusive evidence as to the final estimate that should be placed on an apparently desirable tree. More especially is this true where data can be secured on only a few trees of a kind; but any experience that will be an indication as to what varieties may succeed must be productive of much good.

These few pages are then intended for those people who are desirous of adorning their grounds with fine trees, and who are thinking of the future as well as for immediate effects.

Most people make the mistake of planting trees just as they receive them from the nursery. It should be remembered, however, that in digging, a large portion of the root system is left in the ground, consequently when trees are planted without cutting the tops back to correspond with the loss of roots many of them die or make an unsatisfactory growth. It may be stated as a general rule that all trees and shrubs, except the conifers, should have a large portion of the tops removed when they are transplanted. All bruised roots should also be cut off with a sharp knife so as to leave a smooth surface which will readily heal.

The use of large trees should generally be avoided, as vigorous young trees, two to four years old, will usually give much the best results. Large trees can be successfully transplanted if a large ball of earth is taken up with the roots, but this is an expensive operation and is rarely carefully done. Where this precaution is not taken the older trees seldom make satisfactory growth and many of them soon fail.

The best time for planting trees in Colorado is in the spring of the year. This is true for the reason that the winds of winter are apt to dry out the trees as well as the soil. The root system not being established, cannot supply the moisture lost by evaporation, therefore the plants die.

Shade trees respond to cultivation and care as well as do other plants. While many trees will make a fair growth in poor soil, yet the best soil will be found none too good. The hole in which the tree is to be planted should be large enough to allow all the roots being spread out naturally, and of sufficient depth to admit of the tree's being set one or two inches deeper than it stood in the nursery. If the soil at the bottom of the hole is hard and uncongenial some of it should be removed and be replaced with a generous layer of loose top soil. After the tree has been placed in the hole and its roots properly spread out, the soil should be filled in a little at a time and firmly tamped around the roots so that no cavities can be formed.

As soon as the tree is planted water should be turned on until the ground is thoroughly moist. Especial pains should be taken during the first summer to see that the ground around the tree does not become dry; neither should it be kept too wet. Later in the season less water should be given so that the trees may ripen their growth for winter, as it too often happens that the foliage is frozen from the trees instead of ripening naturally as is indicated by autumn tints. The injudicious use of water late in the season is undoubtedly the direct cause of much of the winter killing of trees.

On the other hand, care should be taken that the ground does not become dry during the winter. If sufficient moisture is not present in the soil to replace that which is lost by transpiration from the branches the tops "freeze dry." In most soils trees will be benefited by a watering in the latter part of November or the early part of December. The necessity of subsequent irrigations will depend upon the weather conditions, but close watch should be kept through the winter to see that the ground does not become too dry.

The amount of damage that is done to shade trees by careless and aimless pruning is difficult to estimate, but the results are to be seen on every hand. With the advent of spring the mania for "cleaning up" comes on and the trees are often the first objects to be attacked. One reason for this no doubt is that a large showing for one's labor can be made in a short time.

People who attempt to prune trees ordinarily have one of two ideas in mind. The more common idea, perhaps, is that the branches of all trees should be removed from the lower two thirds of the trunk. The result is a stiff, bare trunk with a few branches at the top—the ungainly remains of what might otherwise have been a beautiful tree.

The other idea is that when trees have nearly or quite completed their growth the tops should be cut back—regardless of the size of the trunk or branches. Some trees, like the cottonwood, will stand such abuse fairly well, but they are mutilated for the rest of their lives. Fortunately many kinds of trees do not live long after such heroic treatment.

Although shade trees usually need but little pruning, that which is needed should be done systematically, and the natural shape of the tree should always be borne in mind. Specimen trees should as a rule never be pruned except when they are planted, as mentioned above, and as occasional sprawling branches or bad forks are likely to be formed. Street trees likewise need but little pruning except that the head should usually be started about ten feet above the surface of the ground. In any case each tree should be allowed to assume its natural form as much as possible.

Another mistake which is commonly made is that of planting trees too close together. One is naturally desirous of securing quick effects; and as a means of securing this end close planting is commendable, providing the surplus trees are removed as soon as they begin to crowd. But this appears to be a difficult matter for the average person to do.

In some towns double rows of cottonwood trees, the trees ten feet apart in the row, may be seen, one on each side of the sidewalk. The result is a thicket of ungainly trees which serve no purpose that would not have been gained had there been but one row and the trees placed three or four times as far apart.

The majority of trees on most streets should be planted 40 feet apart. Then if quick effects are desirable, the rapid growing Carolina poplar may be planted temporarily between the slower growing kinds, thus making the trees 20 feet apart. The temporary trees should be removed at the first sign of crowding and those that remain will soon fill in the gaps.

Most of the trees here mentioned are propagated ordinarily by seeds, a few by cuttings and layers, while some, as the elms, basswood, catalpa and black walnut, sprout readily from the stump. If one strong shoot is allowed to grow a new tree may be secured in a comparatively short time in this way. Seeds of most trees ripen in autumn and may be planted then where they are to grow, or they may be stratified and planted in spring. Stratification consists of mixing the seeds with moist sand, or alternate layers of seeds and sand which may be placed in barrels or boxes and kept out doors. The alternate freezing and thawing to which they are subjected during the winter, when thus exposed, is necessary to enable the seeds of many trees to germinate.

A tentative list is given below of the kinds of trees which are foreign to the state that are known to be growing in Denver:

Elm, American	Birch, White
" Cork	" Black
" Red	" Weeping
" Scotch	Oak, Red
Ash, Blue	" Burr
" Green	" White
" White	" Swamp
" European	" English
" Weeping	" Pin
Mountain Ash,	Willow, Weeping American
" " Oak Leaved	" Weeping European
" " Weeping	" Laurel Leaf
Locust, Black	Poplar, Carolina
" Clammy	" Lombardy
" Honey	" Silver Leaf
" Honey Thornless	" Siberian
Maple, Soft	Tulip, or Yellow Poplar
" Sugar	Chestnut, Sweet
" Norway	Mulberry, Red
" Sycamore	" Russian
" Wiers Cut Leaf	" White
" Japan	Sycamore
Black Walnut	Hawthorn, sp.
Butternut	Hackberry
Horse Chestnut	Cherry, Black, of commerce
Buckeye	Kentucky Coffee Tree
Catalpa (Speciosa)	Russian Olive
" (Bignonoides)	Allanthus
Linden, American	Red Bud
" European	Persimmon
	Cucumber Tree

Many of these kinds have not been tested long enough to warrant further notice at this time, and not a few must eventually prove to be unsuited to our conditions. A few of the more promising kinds, those that now show every indication of being of permanent value, have been selected for description and illustration:

AMERICAN ELM.

(*Ulmus Americana* L.)

Few trees equal and probably none surpass the American elm for street planting in the Northeastern States, and trials have shown it to be one of the most desirable trees for this purpose in Colorado. There are several recognized forms or types of this tree, the commonest being the vase shaped type. This is specially suited to avenue planting, as the trunk divides some distance above the ground into numerous branches which gradually spread toward the tip and, as the tree acquires age, become more or less arched, thus producing that pleasing effect so noticeable in elm avenues of long standing.

While pre-eminently an avenue tree, this elm is equally suited for planting about the home and in parks and public grounds. The top is usually carried high above the ground, especially when grown among other trees, thus furnishing shade without impeding free circulation of air.

The airy grace and majestic bearing of the elm when well grown, likewise make it a most desirable tree to plant where generous artistic effects are desired. It is a rapid growing tree when young and also long-lived, qualities which are not often found in the same species. While this tree does best in a rich, moist soil, it is adapted to a variety of situations and soils where water can be supplied. Its wood is tough and hard to split qualities which enable it to withstand severe winds and storms.

It occasionally happens that sleet storms load the tops with ice to such an extent that the more upright branches are broken down. This trouble is no more liable to occur in this state, however, than in other portions of the country where the elm is grown, and in most cases the trees are capable of making a rapid recovery after the damaged branches are removed, owing to their ability to push out new shoots.

Young trees of this species sometimes show a straggling habit of growth which can be usually corrected by a little judicious pruning. As with most trees the elm does best and makes the most perfect specimens when planted young and when the least amount of root pruning is necessary.

Several other forms of elms can be seen in the city among which may be mentioned the cork, Scotch and English elms. All of these kinds appear to be desirable and some of them may prove to be better adapted to our conditions than the common white elm.

The various kinds of elms are commonly propagated by seeds which usually ripen in May or June. The seeds should be sown at once and the most of them will soon germinate, but a few may remain dormant until the next spring.

Many insects attack the elm, among which the elm leaf beetle has been quite destructive. None of these pests have appeared, as yet, in Colorado.

ASH.

(*Fraxinus* sp.)

There are three species of this tree which closely resemble each other, and any one of which may be meant when the name ash is used for those grown in this state. They are the white, the green and the red ash. Probably in most cases the green ash is the one oftenest seen and is the one most highly recommended by writers on the subject of trees for prairie planting. The ash is one of our most reliable trees for ornamental planting in this state and is capable of making a good showing in any situation where the cottonwood can be grown. It is a rapid grower, producing a somewhat rounded head of clean, dark green foliage, which assumes a bright yellow tint in autumn. Its leaves are compound, each being composed of five to nine leaflets arranged along a common stalk, thus resembling quite closely those of the walnut. Thus its foliage contrasts well with trees having large simple leaves and they are also pleasing when seen in mass.

The ash is well adapted to streets and other places where more exacting trees would fail. Thus it is hardy, its wood is tough and not easily broken down by storms and the tree is moreover capable of withstanding drought to a considerable extent. It is especially suitable for prairie plantings for wind breaks and for shade. It can be easily grown from seeds which should be mixed with sand and kept in a shed or they may be spread on bare ground in the fall and covered with boxes or boards. In the spring the seeds should be planted in rows in a seed bed somewhat sheltered from wind and full sunlight and supplied with water.

A few years ago borers attacked the ash trees of Denver in alarming numbers and it was feared for a time that all of these trees would be destroyed. But the result has not been so serious as was anticipated, and today the insects are not as numerous as they were three years ago.

HONEY LOCUST.

(*Gleditsia triacanthos* L.)

The honey locust is a tree which has been favorably known for a number of years in the Middle Western States, where it is quite extensively

planted as a street tree and for wind breaks and hedges. It is readily distinguished from the common black locust by its smoother bark, the presence of large branched spines on the trunk and branches, and by its leaves, which are twice compound. The pods also differ from those of the black locust, being much larger and having a twisted shape. A thornless variety of the honey locust occurs which is especially desirable where the presence of spines is objectionable.

The form of this tree is quite variable, being rather broad and low in open situations, but running up pretty well when grown among other trees. It is a graceful tree, the small leaflets closely arranged, giving its foliage an unusually delicate appearance especially when contrasted with that of other trees.

The honey locust, while not quite hardy in the northern parts of Colorado, is capable of making a good growth in most sections of the state and is capable of enduring considerable drouth. The wood is hard and strong besides being very durable, moreover it is not subject to the attacks of borers, so often destructive to the black locust.

This tree is readily grown from seeds which should be collected in the fall and kept dry until spring. The seeds are so hard that they are not apt to germinate the first season unless they are first scalded with hot water just previous to planting. This treatment, if sufficiently thorough causes them to swell, after which they should be planted at once in a well prepared seed bed. The seedlings should receive some protection during the first winter by either heavy mulching or laying down.

BLACK LOCUST, YELLOW LOCUST.

(*Robinia pseudacacia* L.)

The common locust possesses many of the most desirable qualities as a utility tree for the state of Colorado, since it is readily propagated by seeds and root cuttings, is a rapid grower, resists drought well and is hardy. The wood, moreover, is hard, heavy, of good fuel value and resists decay to a remarkable degree. In thick plantations this tree makes a single trunk of slender growth, suitable for fence and telephone posts and may in time reach a sufficient size to furnish material for railroad ties.

This locust is also much grown as a shade and ornamental tree. Its foliage possesses a delicate texture due to the small size of its leaflets and when in bloom the tree presents a very attractive appearance and gives off a most delicious fragrance. When grown in open places the trunk does not often run up far before dividing several times, in which respect it resembles the elm. The smaller branches are beset with stiff prickles which occur in pairs at the base of each leaf stalk, thus making it an unpleasant subject to handle, but, like the honey locust, smooth forms also occur. This tree frequently sprouts, especially when the roots are injured in any way, and when cut the stump sends up strong shoots.

The most serious drawback to the growing of the black locust in the Eastern States is the fact that this tree is especially subject to the attacks of borers which, while they do not at once kill the tree, yet cause great injury to it. Moreover the wood is so perforated by these pests that the trunk is often rendered practically worthless. While these enemies of the locust have not yet appeared to trouble this tree in places where it is now growing in this state, it is possible that in time they may be found, especially if the tree becomes common. But before this does occur it is probable that locust plantations may be grown to sufficient size to make them paying investments.

The tree is usually grown from seeds, which should be treated the same as those of the honey locust.

SUGAR MAPLE. HARD MAPLE.

(*Acer Saccharum* Marsh.)

It is doubtful if any tree is held in greater esteem than the sugar maple by those who are familiar with the tree as it occurs in the hard wood

portions of the Northeastern States. The maple grove has always been a favorite place wherever it exists, for a local celebration, the family picnic or a quiet stroll. And surely it is difficult to find a pleasanter spot, whether it be in the early spring when the sugar season is on, during the heat of summer, shut off by the dense foliage, or when the glorious tints of autumn are glowing in unrivaled shades of yellow and crimson from the dying leaves.

Being a rather slow growing tree, it is also enduring when favorably situated. In its typical form it is a round or oval headed tree if grown in sufficient room, but specimens occur which possess a tendency to stretch upward, like the one shown in the picture. The foliage of the sugar maple is usually quite dense and clean, making it one of the most desirable trees where strong shade and freedom from litter are wanted.

Its wood is hard, strong and of the highest value for fuel. "Curly" and "birdseye" maple are varieties of timber obtained from this tree and possess a high value in cabinet work. In sections where the sugar maple naturally occurs, it is one of the favorite street trees and many beautiful avenues of this tree exist. Its hardness, freedom from litter and its beautiful display of autumn tints are qualities not excelled by any other tree in the Northern Middle States.

This tree sometimes suffers from sun scald where the trunk is exposed and in sections where there is great variation in winter temperature, and for this reason some protection is needed for the trunks especially when young. While no extensive trials have been made in growing the sugar maple in Colorado, the many desirable features of this tree make limited plantings worth while in places where the exposure is not too great and where water is available for irrigation.

The soft, or silver maple (*A. Saccharinum* L.) has been extensively planted in Northern Colorado towns as a shade and street tree. While many of these trees have proven satisfactory, no doubt a greater number have died, and the light colored foliage of those that are falling may be seen on all sides. This species, when growing naturally is at its best on the banks of streams where it is supplied with an abundance of moisture. The extremes of moisture that are common under irrigation, especially if the soil is heavy, appear to result in the death of the smaller roots; at any rate the lack of feeding roots on dying trees is always very noticeable and uncongenial soil conditions must be the cause of the trouble.

This experience has been so universal that we do not hesitate to condemn the use of this tree in most sections of the state.

The maples are propagated by seeds which may be sown in autumn or they may be stratified and sown in the spring. A few kinds ripen their seeds early in the season and these should be sown as soon as they are mature.

NORWAY MAPLE.

(*Acer Platanoides* L.)

In general this tree much resembles the sugar maple, but differs in its lower, more rounded head and dense foliage of a dark green color. Its compact form, clean trunk and thick foliage possess the sturdy aspect of a tree fostered in a rugged country and under the ocean's breath. In addition to these characters the Norway maple holds its foliage later than any other maple, the leaves turning a bright yellow before falling. It has proven to be a very hardy tree and capable of making a healthy growth in the city of Denver.

On account of its low, compact habit of growth, this tree is especially adapted for planting in door yards and parks and where dense shade is desired. It is also an admirable tree for streets and avenues. Some of the varieties of the Norway maple make excellent specimen trees for open situations in parks and yards. For this purpose the purplish leaved varieties may be recommended. The foliage when first put out is a bright purple color, which changes somewhat to a greenish purple as the season advances.

This tree is suitable for planting wherever the sugar maple is capable of growing, and in many cases may prove harder than the latter. Propagation—by means of seeds sown in autumn or stratified and planted in spring.

BASSWOOD.*(Tilia americana L.)*

The basswood is one of the most conspicuous trees in the native forests of the Middle States, where it often reaches the height of seventy feet with a trunk diameter of three feet. While possessing somewhat the aspect of the catalpa, the young basswood is lacking in the coarseness of foliage and branches so characteristic of that species and is well suited to take the place of the catalpa for shade and foliage effects. The basswood when grown in open situations assumes an oval or rounded form of pleasing proportions. The large obliquely heart-shaped leaves have the margins coarsely serrate, are of a bright green color and are arranged alternately on the rather slender branches, the latter being covered with a smooth gray bark.

The inner bark of the basswood is extremely tough and is capable of being readily split into very thin strips, which are often used, where the tree is plentiful, for binding fodder. Its wood is soft, light and almost white in color, there being scarcely any difference in this respect between the sap and the heart wood.

In spite of the fact that the timber is of low fuel value and that it decays rapidly when placed in the soil, still the great variety of uses to which the wood of this tree is put and the fact that it is a hardy and rather rapid growing tree suggests it as a desirable introduction into the timber plantation.

So far as it has been tried in this state the basswood has made a satisfactory growth and is to be recommended as a suitable street and lawn tree, especially where variety in foliage is desired. In addition to this the tree is attractive when in bloom, for the flowers, while not large, are numerous and fragrant and are capable, moreover, of furnishing a fine quality of nectar for honey bees.

The usual method of propagation of the basswood is by means of the fruit, which should be stratified in moist sand in an exposed place and planted in the seed bed the following spring. Many of them may fail to germinate the first year.

In timber plantations this tree readily propagates from the stump, which sends up numerous strong shoots, and by thinning these out new trunks of good form may be secured in a comparatively short time.

HACKBERRY.*(Cellis occidentalis L.)*

This tree, while not as well known as it should be, is of wide range, having been found as far west as the Rocky Mountains. While in general appearance closely resembling the elm, the hackberry is capable of making a satisfactory growth wherever the elm succeeds, in many cases proving hardier than that tree. It has been used to some extent in Western Kansas and in Minnesota, where it is recorded as one of the best trees for ornamental planting.

It does not usually make as large a tree as the American elm, but is the equal of that tree in its slender gracefulness of limb, while the leaves are so similar in shape as to be readily mistaken for those of the elm.

While the hackberry is capable of making the best growth only in rich, moist soil, it is, nevertheless, able to do well in dry situations. It is well suited for street planting and is especially desirable for door yards and small grounds on account of its moderate size and pleasing appearance.

The hackberry is propagated from seeds which are found in the small, cherry-like fruit borne singly on the twigs. These may be sown in autumn or stratified until spring.

THE WESTERN, OR HARDY CATALPA.*(Catalpa speciosa Warder.)*

A great deal has been said and written in recent years about the catalpa as a utility tree which could be readily grown to supply the great

and increasing demand for fence posts, railroad ties and telephone poles. It does indeed possess some of the most desirable qualities for such purposes, such as ready propagation by seeds, rapid growth and great durability of its wood in contact with soil. Its adaptability to different locations, however, has frequently been overestimated and in consequence plantings of this tree for its timber have sometimes proven unsatisfactory or even complete failures when attempted outside of its natural range. Thus the catalpa has proven undesirable in the more northern parts of the country on account of its liability to winter injury. But when planted in sheltered locations and in rich soil it has made a good showing and is useful as an ornamental tree for parks and dooryards, and where a variety of foliage effects is desired.

The catalpa, as shown in the illustration, is an upright growing tree with coarse twigs and large leaves. It is a showy tree when in bloom, the large clusters of whitish flowers faintly spotted with purple giving it an attractive appearance. In many places this tree has been extensively planted along streets and boulevards, but it seems poorly suited for such purposes, as it is apt to assume an ugly and ungraceful appearance, in many instances showing dead and bare limbs which the coarse foliage fails to conceal. Its most desirable use as an ornamental tree is shown when grouped among or against a background of other trees and where there is plenty of room in the foreground.

Many of the earlier attempts at growing the catalpa failed for the reason that the Eastern species (*C. bignonioides*) was substituted for the harder Western kind. The former species is entirely worthless in Colorado, and too great care cannot be taken to get seeds from reliable people. Seeds should be planted in the spring in a well prepared seed bed. In some localities cuttings root easily when placed in moist soil.

BLACK WALNUT.

(*Juglans nigra* L.)

The black walnut has always held a prominent place among the most valuable native trees of North America. At one time the forests of the Middle Eastern States contained many magnificent specimens of this tree, but the high value set upon its timber led to their early removal, so at the present time it is rarely that one sees the black walnut as it grew in the primeval forest.

It is not uncommon, however, to see the black walnut used for street and roadside planting in its native range, as it is of moderately rapid growth when young, presents an attractive appearance and the nuts are highly esteemed by many persons. Plantations of this tree for its timber are apt to be somewhat disappointing on account of the fact that the wood does not assume the rich, dark brown color, which has made it so much used in cabinet work, until the trees are of great age. But before this occurs the young trees may be used for fuel and for posts, the durability of its wood making this tree one of the desirable kinds for the latter purpose.

For satisfactory results the black walnut should have a rich soil and a fairly constant water supply, under which conditions it has made an excellent growth in this state. It is particularly suited to parks and similar places, where it can have room to develop on all sides, when it assumes a rounded top of considerable density.

Its foliage slightly resembles that of the ash but is more attractive, being composed of numerous pairs of leaflets arranged on long stalks, which remain on the tree for some time after the leaflets are shed. The trees begin to bear nuts when ten to fifteen years of age.

This tree is quite readily propagated by means of the nuts, which should be gathered when mature, stratified over winter and planted in spring. Or the nuts may be planted in autumn where the trees are to stand. The black walnut does not transplant readily, when over a year old, unless the precaution has been taken to cut the long tap root while the trees were small.

THE BIRCHES.*(Betula sp.)*

Among the birches are found some of our most graceful ornamental trees. As a group they are characterized by their slender branches and small open foliage while the bark in many species is smooth and possessed of some characteristic color. The wood of the larger kinds is much used in the manufacture of small wooden articles, while the curly grained individuals furnish valuable lumber for cabinet work.

The black birch (*Betula occidentalis*) is the principal native tree of this group in Colorado. It is a rather small tree, sometimes reaching a height of twenty to thirty feet, with bark of a bronze color. It is seldom planted, but is capable of being used to lend variety to ornamental tree plantings.

The European white birch (*Betula alba*) is a native of Europe, but has been extensively used in America as an ornamental tree, where it is becoming naturalized. It is a slender, graceful tree, reaching a height of thirty to forty feet. Its most noticeable feature is the chalk white color of the bark, on the trunks and older branches, which makes it a striking tree especially in the winter when planted in front of a group of evergreens. It is much used on this account for parks and public as well as private grounds.

The cut-leaved weeping variety of the white birch is the embodiment of delicate, airy grace and is largely used in the place of the species especially where daintiness and contrast are desired. It sometimes reaches a good size in favorable locations where moisture is unfailing, but it is not a longlived tree. In spite of this fact, however, it is one of the desirable ornamental trees for lawns and parks.

The birches may be grown from seeds sown in autumn or stratified over winter. The ornamental varieties are increased by budding and grafting on the parent species.

SYCAMORE, PLANE TREE.*(Platanus Occidentalis L.)*

The sycamore occurs principally along streams and river bottoms in the Middle States and often grows to a very large size. In form the tree considerably resembles the cottonwood, but the branches are usually more spreading and crooked than in that species. On the branches and young trunks the bark is smooth and of a greenish white color, but is partly obscured on the old trunks and large limbs by patches of dark gray outer bark. Thus the sycamore presents a rather striking appearance when set off against a background of dark foliage. The leaves of this tree are large with several pointed lobes and a light green color, making it a suitable tree for securing a variety of foliage effects, especially where dense shade is not desired. The sycamore is sometimes known by the name of button-ball tree, from the fact that the small, seed-like fruits grow in dense globular heads about the size of a walnut and these hang on the tree over winter.

The wood of this tree is fine grained, hard and splits with difficulty. It possesses a handsome silver grain when quarter sawed and is used to some extent for interior finishing and for articles of furniture.

While the sycamore has been but little used in the Western States it is a desirable tree for streets and parks and will evidently thrive where planted in good soil and supplied with water. It is propagated by means of the seeds, which may be sown in spring in a seed bed.

THE HORSE CHESTNUT.*(Aesculus hippocastanum L.)*

This tree is characterized by its rounded top of dense foliage, each leaf being composed of five to seven leaflets of large size which spring

from the end of the leaf stalk in a radiating manner. This formation of the leaves gives the horse chestnut a very distinctive character and makes it a desirable tree for securing a variety of foliage effects in ornamental plantings. Being a rather large coarse tree when well grown, it is not as suitable for small areas, as for parks and large grounds where generous effects are wanted.

Like the catalpa, this tree is showy when in bloom, the flowers being produced in large erect clusters and having white petals spotted with purple and yellow. The seeds are of a large size and are produced in a prickly pod about the size of a mature walnut. After the leaves are shed the tree is noticeable among others by its coarse, upright branches, each bearing large terminal buds covered with a sticky varnish.

This tree can be readily grown from the seeds, which should be collected in the autumn, buried in sand before they dry and planted in spring. Or they may be planted in a sheltered seed bed in autumn, where they are allowed to grow the next season.

The horse chestnut has been much used as a street and shade tree in the Eastern and Central States, but is not considered sufficiently hardy for Northern localities. A few trees of the horse chestnut have been planted in the city of Denver and are now sufficiently mature to produce fruit.

While this is about all the data we have regarding its suitability for Colorado, it is evident that the horse chestnut can be successfully grown in any location similar to that of Denver and where moisture and fertility are not scarce.



PLATE I.

AMERICAN ELM.—City Park. Planted about 1883; height 50 feet; circumference 54 inches. Photo Aug. 25, 1903.

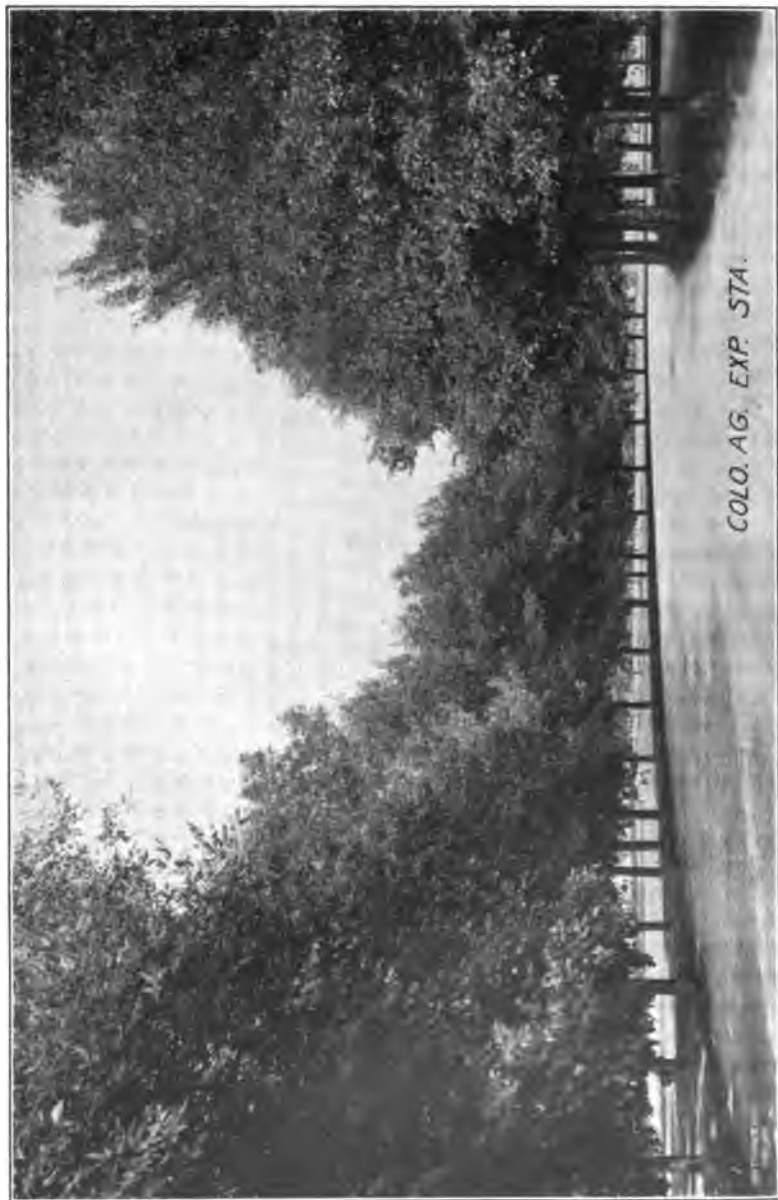


PLATE II.

WHITE ASH AVENUE.—City Park. Planted about 1870; height 33 feet; circumference 30 1-3 inches. Photo Aug. 16, 1903.



PLATE III.
BLACK LOCUST AVENUE.—City Park. One tree in Denver twenty-six years old has attained a height of 60 feet,
and a circumference of 71 inches.



PLATE IV

SUGAR MAPLE.—Grounds of Mrs. L. A. Howard. Planted 1883; height 33 feet; circumference 23 inches. Photo Aug. 16, 1903.

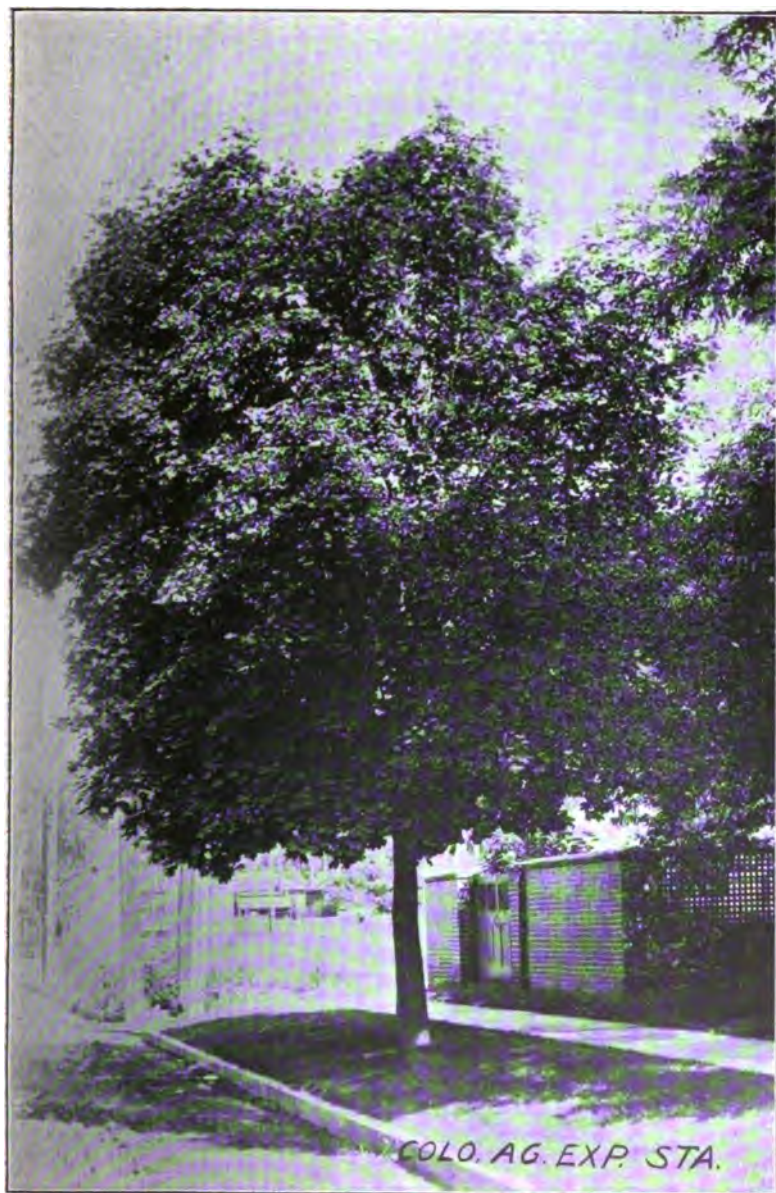


PLATE V.

NORWAY MAPLE.—Grounds of Mrs. L. A. Howard. Planted 1883; height 25 feet; circumference 25 1-2 inches. Photo Aug. 16, 1903.



PLATE VI.

AMERICAN LINDEN.—Fairmount Cemetery. Planted 1891; height 23 feet; circumference 23 inches. Photo Aug. 16, 1903.



PLATE VII.

HACKBERRY.—Fairmount Cemetery. Planted 1891; height 28 feet; circumference 26 inches. Photo Aug. 16, 1903.



PLATE VIII.

CATALPA SPECIOSA.—Campus, Agricultural College, Fort Collins. Planted 1889; height 30 feet; circumference 48 inches. Photo May, 1903.

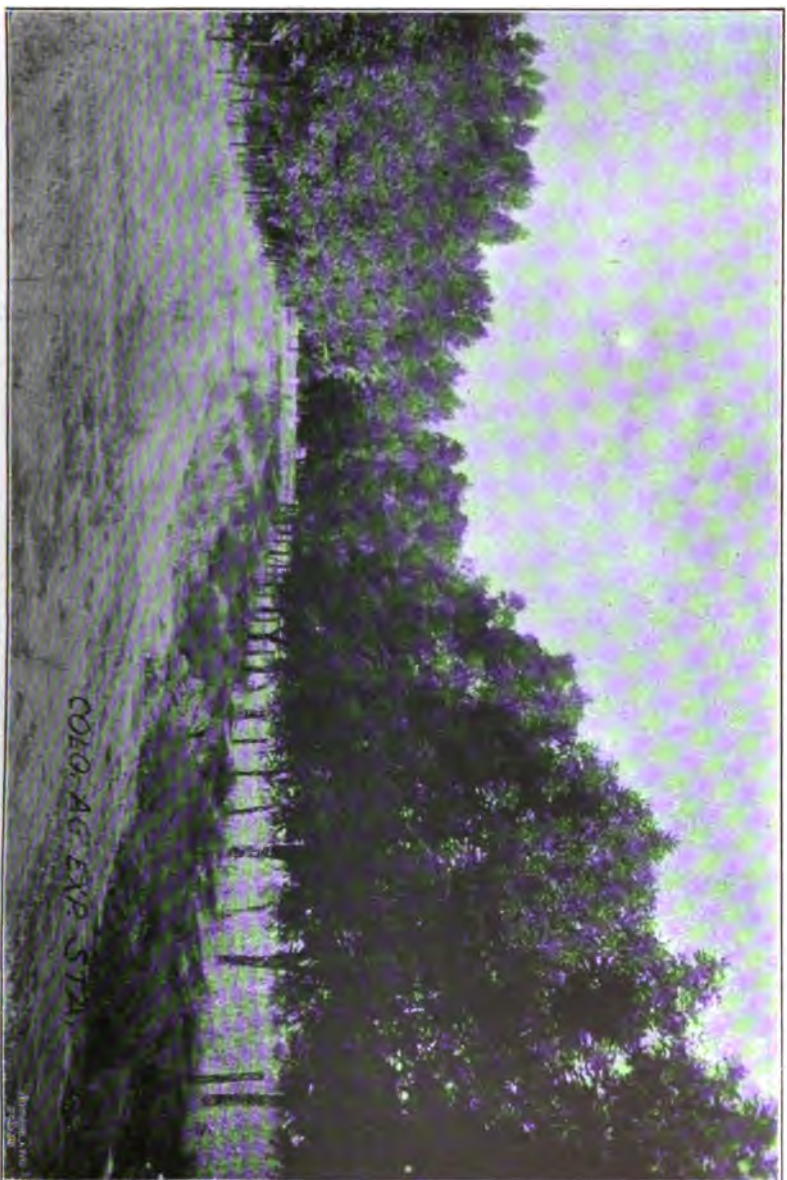


PLATE IX.

BLACK WALNUT.—Walnut Street. Planted about 1878. Ten of the large set have a circumference of 30 inches and over. Photo Aug. 16, 1903.



PLATE X.

CUT LEAF BIRCH.—City Park. Planted about 1885; height 30 feet; circumference 18 inches. Photo Aug. 16, 1903.



PLATE XI.

ENGLISH OAK.—Fairmount Cemetery. Planted 1891; height 30 feet; circumference 31 inches. Photo Aug. 25, 1903.



PLATE XII.

SYCAMORE.—Grounds of C. B. Kountze. Planted 1880; height 37 feet; circumference 47 inches. Photo June 7, 1903.



PLATE XIII.

HORSE CHESTNUT.—Grounds of W. N. Byers. Planted 1897; height 15 feet; circumference 14 inches. Photo June 7, 1903.

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February, 1905

The Agricultural Experiment Station

OF THE

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Feeding Steers on Sugar Beet Pulp, Alfalfa Hay and Farm Grains.

By W. L. Carlyle, C. J. Griffith and A. J. Meyer.

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Feeding Steers on Sugar Beet Pulp, Alfalfa Hay and Farm Grains.

By W. L. CARLYLE, C. J. GRIFFITH and A. J. MEYER.

The data presented in this bulletin is published at this time for the benefit of cattle feeders in those sections of the country where the growing of sugar beets is coming to be a leading industry. For several years past there has been much interest manifested concerning the value of sugar beet pulp as a factor in beef production. The experiment described in the following pages was not intended to, and does not, show the actual feeding value of beet pulp. It does show, however, that this by-product has a considerable value as a feed, and may be made to play a prominent part in economical cattle feeding.

The experiment was made possible through the liberality of the Great Western Sugar Company, of Loveland, Colo., who furnished the cattle, the feed and equipment, and a part of the labor for carrying on the work. The Experiment Station greatly appreciates the kindness and the progressive spirit of Mr. C. K. Boettcher, president of the company, in thus supplying to the Station this means of testing the value of sugar beet pulp combined with alfalfa hay and farm grains as a feed for cattle.

The Station is also indebted to the U. S. Department of Agriculture, through the Bureau of Animal Industry, for financial aid in carrying on this experiment.

The results of this trial are not considered as final or conclusive, but are published in the hope that the data gathered from this initial experiment may be of some benefit to the prospective cattle feeder. Arrangements are already under way for a more complete and elaborate experiment with these feeds during the coming winter, when an effort will be made to determine the actual feeding value of sugar beet pulp as compared with other standard feeds.

The great cattle ranges of the western states have for many years supported large herds of breeding or "she" stock and have grown immense numbers of calves, yearlings, and two and three year old cattle to supply the feed lots of the Middle West, or corn belt, with feeders. Frequently this is a very profitable business for the ranchmen of the West, but at times when corn is a light crop or a partial failure, there is little demand and low prices for feeders and the ranchman must either keep his cattle until a corn crop is assured or sacrifice them at less than cost. In those sections of the West where water can be secured for irrigation purposes, ranchmen have frequently made a success of cattle feeding during the winter months. The alfalfa plant seems to have found in the irrigated sections of this western country its most congenial environment. The yield per acre is large and the quality is usually excellent owing to the fine weather that always prevails during the growing and harvesting seasons. The small grains grown in these regions are also of superb quality. The proximity of the snow capped mountains and the high altitude renders the nights rather cold and the growing season is a comparatively long one, resulting in a very heavy yield of rich and nutritious grains.

During recent years, however, the growth of the beet sugar industry has presented many new problems for solution. Prominent among these are the maintenance of the fertility of the soil, the profitable disposition of the alfalfa crop, which rotates best with the sugar beet crop, and last, and by no means least important, the proper utilization of the beet pulp, a by-product from the sugar-factories. It is estimated that at least 60 per cent. of the total weight of the beet crop, exclusive of the tops, is returned as beet pulp with practically no change in its composition except the extraction of the greater portion of the sugar content of the beet. Since many ranchmen and stockmen of the West are not familiar with the process of sugar making from beets, a few words of explanation as to what beet pulp is, and how it is secured, may be appreciated. When the beets are received at the sugar factory, they are first thoroughly washed and then carried to the slicer where they are cut into small strips about two inches long, one-fourth inch wide, and one-sixteenth inch thick, called "cossettes." They pass directly from the slicer into large tanks where running water extracts the sugar. The pulp, after the extraction process is complete, is drawn from these tanks at the bottom and transferred to a press where all the free moisture is expelled and is then transferred by means of screw carriers to a large flat pit or reservoir outside, termed the "silo." In this pit the pulp is piled ten or twelve feet deep and rapidly forms an air tight crust on the surface which preserves the lower layers per-

fectly. Any surplus water is drawn off through the drains provided and the pulp instead of deteriorating in palatability and feeding value, is actually improved in these respects after being siloed for several months. At the close of this experiment, the freshly uncovered pulp was sweet and pleasant to the taste and presented an odor almost identical with freshly pulped beets. At this time it appeared much drier than earlier in the season and the cattle appeared to be fonder of it, though they would not consume it in such large quantities. In some of the factories the pulp is carried from the building by flushing with water through elevated sluice boxes. From the past season's experience, it is apparent that this is a very objectionable practice on the part of the sugar companies and should not be followed when the pulp is desired for feeding purposes. From the six sugar factories operating in Northern Colorado during the season of 1903, there was produced at least two hundred and twenty-five thousand tons of beet pulp, all of which was available for stock feeding purposes. The area from which the beets were grown is all contained in three adjoining counties, and there were at least three hundred thousand tons of alfalfa grown in these same counties last year. These figures give some idea of the possibilities there are for successful meat production in this region.

THE OBJECT OF THE EXPERIMENT.

This experiment was undertaken for the purpose of determining:

First.—If beet pulp in combination with alfalfa hay is a suitable food for fattening steers.

Second.—If under ordinary conditions it would be profitable to feed grain in addition to the pulp and alfalfa hay.

Third.—Which grains can be fed to the greater advantage, corn or the home grown grains, barley and oats combined.

In addition to the above, it was desired to learn what effect, if any, the various rations fed would have upon the meat produced, as it was considered by many that an exclusive ration of pulp and alfalfa hay would not produce a good quality of edible meat.

PLAN OF EXPERIMENT.

In planning the experiment, it was decided that all the conditions surrounding it should be as nearly similar as possible to the practices of the cattle feeders in this section. The cattle selected for the experiment were purchased on the open market at Denver in October, and consisted of 150 head of two year old grade Shorthorn and Hereford steers. They had all been bred by one man and had been given the same care and feed from birth

until purchased. The price paid was \$2.85 per hundred weight, which was low, as the cattle were a fair average lot of feeders. The entire lot of cattle were fed together on pulp and hay for several weeks prior to the beginning of the experiment for the purpose of getting them accustomed to the feed. No shelter of any kind was provided for the cattle during the entire feeding period. The hay was fed from the ground, the animals securing it by passing their heads through a rack made of poles, which prevented waste from trampling. The pulp and grain were fed from long flat boxes or "bunks" set up from the ground on legs. The enclosing and division fences were constructed of posts and barbed wire.

On December 19, the 150 head of cattle were divided as equally as possible into three groups of 50 each. General conformation, breed characteristics, as well as size and weight were made the basis for this division.

In table I is given the weights of the steers in each lot when the experiment was started, from which it may be seen that the steers were not better than a good average bunch of feeders.

TABLE I. GIVING INITIAL WEIGHT OF STEERS.

	LOT I.	LOT II.	LOT III.
Total.....	45,880	44,960	45,278
Average	917.6	899.2	905.6

Feeds and Feeding.—The steers in each lot were given all the alfalfa hay and beet pulp they would consume without excessive waste. In addition, Lot I was fed a light ration of ground barley and ground oats, two parts by weight of barley to one of oats. Lot II was fed the same amount of ground corn as Lot I received of barley and oats. No grain of any kind was fed to the steers in Lot III during the experiment. A large wagon scale was provided for weighing the steers each week and also for weighing the hay and beet pulp to each lot. The grain was weighed out each day, as fed, from a small platform scale.

The grain supplied was much below the average as it was purchased from time to time from the local mills and varied greatly in quality. The barley and oats were particularly noteworthy in this respect as they frequently contained a large percentage of wild oats. This was unavoidable, as we could not control the purchase of the grain. At different times as the experiment progressed, new lots of hay were purchased for each lot of cattle, so that no attempt was made at such times to keep a record of the daily consumption of hay by each lot, the total weight being charged to each lot and the average amount eaten daily and weekly calculated therefrom.

DISCUSSION OF RESULTS.

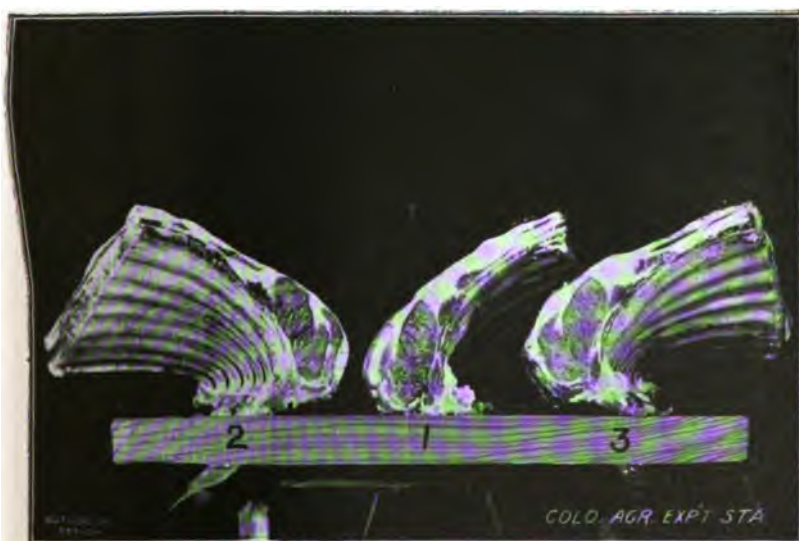
In the accompanying table is given the detailed data of the weight of steers, the amount of the different feeds consumed and the gains made by each lot in one and five week periods, and for the entire period of twenty-five weeks.

A study of the contents of this table and the summary as given in Table III, reveals some interesting features. It will be observed that after the first seven weeks of feeding, there was a marked falling off in the amount of pulp consumed by the steers in Lots I and II that were receiving grain, and that this decrease continued until the close of the experiment, while the steers in Lot III, that received no grain, continued to eat approximately the same amount of pulp throughout the experiment, until the last four weeks, when they also ate perceptibly less. The steers in each of the lots ate about the same amount of pulp for the first seven weeks of the experiment. This may be accounted for from the fact that the amount of grain received daily by each steer was so small at the beginning of the experiment that it had no appreciable effect upon the appetite for the other feeds. The steers in Lots I and II received two pounds of grain per day each, for the first two weeks, after which time this quantity was increased at the rate of one-half pound per week until they were receiving on an average six pounds each daily. This continued until the 13th week of the experiment, when they were fed seven pounds each daily for one week until the 22d week, when they had eight pounds, and from that time until the close of the experiment they had ten pounds each daily.

It is interesting to note in the case of Lots I and II receiving grain, that while the amount of pulp consumed daily diminished with an increase in the grain ration, the average daily consumption of hay remained fairly constant throughout the experiment, while there was a constant increase in the amount of hay consumed by Lot III that received no grain. It seems hardly credible that the steers in Lot III should consume approximately 60 per cent more of hay in the last five weeks of the experiment than they did in the first five weeks. Another striking feature of this table will be noted in the fact that while the amount of grain fed daily to the steers in Lots I and II was increased from week to week, there was no constant or corresponding increase in the rate of gain. Contrary to what might have been expected, there was not any appreciable increase in the rate of gain in Lots I and II with an increase in the amount of grain fed. While the average rate of gain increased somewhat after the first five-week period, when more grain was fed, yet it cannot be attributed to the increase in amount of grain fed, since the steers in Lot III that re-

TABLE II. GIVING FEEDS AND GAIN OF EACH LOT OF STEERS BY WEEKS AND IN FIVE WEEK PERIODS.

Week	FEED CONSUMED						GAIN					
	Lot I 50 Steers			Lot II 50 Steers			Lot III 50 Steers			Lot I 50 Steers		
	Pulp	Hay	Barley & Oats	Pulp	Hay.	Corn	Pulp	Hay.		I	II	III
First.....	lbs	lbs	lbs	lbs	lbs	lbs	lbs.	lbs		lbs	lbs	lbs
Second.....	58478	2603	57671	63440	4288	700	58138	4037		-120	-495	-400
Third.....	63440	2205	700	63440	2010	700	63440	2245		345	675	875
Fourth.....	51476	3780	875	51496	3430	875	51791	3430		161	1490	1050
Fifth.....	55568	3760	1050	55568	3535	1050	55568	3535		615	755	530
Total.....	47236	4385	1225	47236	4385	1225	47236	4385		120	430	575
Sixth.....	276198	17933	4550	276411	17668	4550	276473	17592		3045	2795	2550
Seventh.....	41356	3835	1575	41066	3605	1400	41395	4139		240	750	800
Eighth.....	38883	3535	1575	38833	3415	1575	38833	4101		740	450	500
Ninth.....	34182	3329	1750	33532	3403	1750	33532	3549		1165	1065	505
Tenth.....	37705	3825	1925	38112	4127	1925	41040	3823		425	604	470
Eleventh.....	38461	3825	2100	38591	4137	2100	43411	3823		1620	1700	300
Total.....	189137	18349	8750	189854	18757	8750	201302	19725		4250	4685	2475
Twelfth.....	35561	3825	2100	35516	4137	2100	40246	3823		1445	760	1380
Thirteenth.....	38133	3825	2100	34295	4137	2100	4264	3823		8	23	
Fourteenth.....	29756	3825	2450	31414	3801	2450	41191	4352		-645	475	755
Fifteenth.....	23276	3827	2450	23533	3896	2380	38777	4380		1300	1470	175
Sixteenth.....	21439	3827	2450	27591	3896	2380	42249	4840		920	315	510
Total.....	146164	19130	12250	158352	19507	12250	206407	21758		3020	3020	2820
Seventeenth.....	23535	3827	2450	27980	3896	2380	33425	4840		-150	755	415
Eighteenth.....	27600	3827	2450	27100	3896	2380	31400	4840		1630	940	825
Nineteenth.....	24670	3827	2450	24100	3896	2400	30170	4840		1630	1090	1110
Twentieth.....	29170	3827	2450	24920	3896	2400	43575	4840		300	10	25
Total.....	132110	19092	14000	138605	18490	14000	205766	23893		-638	15	-630
Twenty-first.....	24915	3562	2840	24888	3730	2800	4331	4134		1145	950	1440
Twenty-second.....	22910	3700	3150	23223	4767	3150	40065	5048		940	1070	400
Twenty-third.....	17355	3700	3500	17195	4767	3500	34000	5048		910	1070	430
Twenty-fourth.....	14570	3700	3500	13115	4767	3500	32445	5048		290	320	140
Twenty-fifth.....	15530	3700	3500	16255	4767	3500	34345	5948		615	845	1645
Total.....	95440	18302	16800	102976	22804	16800	186206	26726		3945	3450	4095
Grand Total.....	839049	92806	66350	865198	97226	66350	1076153	109694		16585	17490	13895



Photograph reproductions of cuts of beef from three representative steers, one from each of the lots as numbered in the reproductions.



**Photograph reproduction of representative steer from Lot I fed upon
Alfalfa Hay, Beet Pulp, and Ground Barley and Oats.**



**Photograph reproduction of steers in Lot I fed upon Alfalfa Hay,
Beet Pulp, and Ground Barley and Oats.**



Photograph reproduction of representative steer from Lot II fed upon Alfalfa Hay, Beet Pulp and Ground Corn.



Photograph reproduction of steers in Lot II fed upon Alfalfa Hay, Beet Pulp and Ground Corn.



Photograph reproduction of representative steer from Lot III fed upon Alfalfa Hay and Beet Pulp.



Photograph reproduction of steers in Lot III fed upon Alfalfa Hay and Beet Pulp.

ceived no grain also increased in rate of gain in approximately the same proportion as did the steers in the lots receiving an increase of grain feed from week to week. So far as can be determined from the data obtained, the increase in amount of grain consumed from week to week after the first five weeks of the experiment resulted only in a slight decrease in the amount of pulp consumed and in maintaining a constant consumption of hay, while the steers receiving no grain increased in their consumption of hay.

It is difficult to understand why an average daily grain ration of 9.6 lbs. fed to a group of fifty steers, in conjunction with beet pulp and hay *ad libitum*, as was the case in the fifth five-weeks, would not result in a greater gain than an average daily grain ration of five pounds per day with pulp and hay *ad libitum*, as was the case in the second five-week period. The only conclusion that can be drawn from this data would seem to be that with an abundance of beet pulp and alfalfa hay at prevailing prices, a grain ration of five pounds of either corn or barley and oats will result in a greater gain in the early part of a feeding period than will be produced with a much larger average grain ration toward the close of such period. It should be stated, however, that the steers in all of the lots were transferred from one feed yard to another one six miles distant in the early part of the twelfth week of the experiment, which no doubt accounts in a large measure for the small gains made by all the steers during the third five-week period. Reference to Table II will show that in the case of Lot I, the 50 steers actually lost an average of approximately 13 pounds each on two weeks feed as a result of the change while the steers in Lot II made a comparatively small gain for this same period. While this transfer from one set of yards to another was absolutely necessary owing to the conditions under which the experiment was conducted, and was much to be regretted since it had such a marked effect upon the steers, yet it serves to show how exceedingly important it is to have feeding cattle remain in their accustomed environment. The result in this case on one lot of 50 steers was a direct loss of two full weeks feed and 645 pounds of live weight.

The average amount of the different kinds of feed consumed daily by each steer is shown in Table III. This data has been averaged for each five-week period and for the whole 25 weeks over which the experiment extended.

It will be seen that in the two lots of steers that were fed grain, each steer ate on the average 98 pounds of pulp and about 11 pounds of hay daily, while the steers in Lot III that had no grain, ate on the average, 123 pounds of pulp and 12.5 pounds of hay daily.

TABLE III.

AVERAGE AMOUNT IN POUNDS OF FEED CONSUMED AND GAINS
MADE BY EACH STEER DAILY IN THE DIFFERENT
LOTS IN FIVE WEEK PERIODS.

FIVE WEEK PERIOD	AVERAGE AMOUNT OF FEED CONSUMED.								AVERAGE GAIN		
	Lot I.			Lot II.			Lot III.		Lot I	Lot II	Lot III
	Pulp	Hay	Oats and Barley	Pulp	Hay.	Corn	Pulp	Hay			
First	187.8	10.2	2.8	157.4	10.1	3.6	158.0	10.1	1.78	1.60	1.46
Second.....	108.1	10.5	5.0	118.5	10.7	5.0	115.0	11.3	2.43	2.66	1.41
Third.....	83.5	10.9	7.0	90.5	11.1	7.0	118.0	12.4	1.73	1.78	1.61
Fourth.....	73.5	10.9	8.0	79.2	10.6	8.0	117.6	13.6	1.33	1.97	1.00
Fifth.....	54.5	10.5	9.6	58.8	13.0	9.6	106.4	16.3	2.55	1.97	2.34
Average for entire period	96.9	10.6	6.44	98.9	11.1	6.44	123.0	12.5	1.9	2.0	1.57

TABLE IV.

GIVING AVERAGE AMOUNT IN POUNDS OF FEED REQUIRED BY THE
STEERS IN EACH LOT FOR ONE POUND OF LIVE WEIGHT GAIN.

	Pulp	Hay	Barley-Oats	Corn
Lot I	50.59	5.59	3.39	
Lot II	49.46	5.55		3.22
Lot III	78.58	8.01		

In table IV, which shows the average amount of feed required by the steers in each lot for one pound of gain in live weight, it will be noticed in the case of Lot III that seventy-eight and one-half pounds of pulp and eight pounds of alfalfa hay were required to produce one pound of live weight gain on a bunch of 50 two-year old steers. In Lot I, three and thirty-nine one hundredths pounds of barley and oats fed in the ration of this bunch of steers was equivalent to, or took the place of, twenty-seven and ninety-nine one-hundredths pounds of pulp and two and forty-two one hundredths pounds of hay. The result in Lot II was almost the same, except that it required slightly less of corn to replace approximately the same amount of pulp and hay.

The whole one hundred and fifty head of steers were disposed of to the Western Packing Company of Denver, at a flat price. The steers were weighed in the usual manner at the feed yards before shipping, and were weighed again at the yards in Denver after a short rest with hay and water supplied. In order to obtain the difference in the market value of each lot of steers as they ap-

FEEDING STEERS BEET PULP, ALFALFA AND GRAINS. II

peared when on the market, three of the leading buyers in the yards kindly consented to place a price upon each lot. It will be seen in the summary table that the steers in Lot III fed upon pulp and hay, shrank appreciably more in shipping than either of the grain fed lots. It will also be noted that the steers in Lot II fed upon ground corn in addition to the pulp and hay were valued at ten cents per hundred more than the lot fed upon barley and oats with pulp and hay, and forty-five cents more per hundred than the lot fed pulp and hay alone. It is only fair to state that the gentlemen placing a value on the steers were not informed as to the character of the feed given to any of the steers and consequently could not be even suspected of bias.

TABLE V.

GIVING SUMMARY OF DATA FOR THE AVERAGE OF THE STEERS
IN EACH LOT.

	Lot I. Barley & Oats.	Lot II Corn	Lot III Pulp
Weight at beginning of experiment.....	917.60	899.20	906.80
Value at 8 cents per pound.....	\$ 27.52	\$ 28.94	\$ 27.16
Cost of feed for entire period.....	\$ 21.05	\$ 20.68	\$ 10.87
Cost of feed for 100 lbs gain.....	\$ 6.58	\$ 5.98	\$ 3.79
Cost of labor involved.....	\$ 3.50	\$ 3.50	\$ 3.50
Weight of finished steers at feed lot.....	1,249.80	1,848.00	1,189.50
Sale weight of steers.....	1,218.90	1,216.90	1,149.40
Shrinkage in shipping (lbs.).....	35.70	81.10	40.10
Shrinkage in shipping, (per cent).....	2.86	2.49	2.71
Selling price per hundred pounds.....	\$ 5.50	\$ 5.60	\$ 5.15
Value at selling price.....	\$ 66.75	\$ 68.15	\$ 69.19
Cost of marketing.....	\$ 1.53	\$ 1.54	\$ 1.46
Net profit.....	\$ 12.55	\$18.45	\$ 16.20

RESULTS OF SLAUGHTER TEST.

A very thorough slaughter test was made of each lot of steers at the packing plant, the result of which is summarized in Table VI. In this data, it will be noticed that the caul fat of the lot of steers fed upon barley and oats was noticeably heavier than either of the other lots, while the lot fed upon pulp and hay had appreciably less of internal fat than the steers fed upon corn.

Some data was collected as to the size and condition of the livers, as it was thought that this organ might indicate something of the physical condition of the animals in the different lots. From the data presented, however, it will be noted that there was no appreciable difference in either the size or condition of this organ in the different lots of steers.

When taken to the cooling rooms, the dressed carcasses of the different steers were carefully weighed and the weight recorded; after hanging in the cooling room for several days, the time varying somewhat with the different carcasses but no differ-

ence being made in those from the different lots, it was found that the average amount of shrinkage on each carcass of the steers in Lot I was 15.8 lbs., in Lot II, 17.1 lbs., and in Lot III, 14.6 lbs. These figures were somewhat surprising as it was expected that the carcasses of the steers that had not been fed any grain would shrink more in cooling than those fed a grain ration in addition to the pulp and hay.

TABLE VI.
GIVING DATA FROM SLAUGHTER TEST.

	Lot I Barley & Oats	Lot II Corn	Lot III Pulp
Average weight of caul fat.....	19.2 lbs	17.5 lbs	15.1 lbs
Average weight of livers.....	12.8 lbs	12.6 lbs	12.7 lbs
Numbers of diseased livers.....	4	8	2
Average shrinkage on each carcass in cooler	15.8 lbs	17.1 lbs	14.6 lbs
Average percentage of shrinkage in cooler.	2.11	2.19	2.11

Before the steers were slaughtered, a representative steer from each lot was selected by the three buyers in the yards and the carcasses of these three animals were reserved for a thorough demonstration test on the block where the various wholesale cuts could be compared with a similar cut from each of the other carcasses. Photographs of these cuts were also taken and are reproduced in these pages, from which it will be seen that there was no appreciable difference in the quality or grade of the meat from each of the representative carcasses. Cooking tests were also conducted and if any choice was made by the various parties eating the meats, it was invariably in favor of that produced from pulp and hay alone. As a last and final test, a loin roast from the carcass of the steer representing the pulp and hay fed lot was served to Secretary James Wilson, of the U. S. Department of Agriculture, and a party of his friends in Denver. The Secretary, in response to a request for his opinion of this roast, wrote the following communication which needs no explanation:

"WASHINGTON, D. C., August 15, 1904.

PROF. W. L. CARLYLE,
Fort Collins, Colo.

Dear Sir:—

Replying to yours of the 6th, I have to say that I have inspected and eaten of the beef fed with alfalfa and beet pulp at the Colorado Experiment Station, Fort Collins, Colo. It was of superior quality, indicating that the Mountain states will have no difficulty in finishing cattle with their own forage plants, and making their own meats.

Yours very truly,

JAMES WILSON,
Secretary."

SUGGESTIONS TO FEEDERS.

In feeding pulp, absolute cleanliness should be observed. The pulp should be fed in troughs or "bunks" provided for the purpose. Only such an amount of pulp should be fed at one time as the cattle will clean up with reasonable waste, and the bunks should be cleaned out daily. Unless this be done, the bunks will gradually become filled with frozen pulp in cold weather, and with foul and decaying pulp during warm weather.

Pulp which has been "nosed" about and breathed upon for some time will usually be refused by the cattle. To avoid the possibility of waste on this account, and to insure profitable gains, feed often and in small quantities. It is folly to place a large quantity of pulp into the feed troughs with the intention of having a single feed last the greater part of a day. The inevitable result of such a course is to throw some of the cattle off their feed causing an unreasonable and unwarranted waste of pulp.

Pulp should never be fed late in the afternoon during cold weather. The cattle generally refuse to eat after nightfall and whatever remains in the bunks freezes before morning and occasions no little difficulty in removing it before the fresh pulp is placed before the cattle.

Pulp has a laxative tendency. On this account it is well to feed good alfalfa hay of the first cutting with the pulp where it is convenient to do so. The later cuttings of hay are more apt to encourage scouring and bloat, although where care and judgment are exercised this condition can be largely avoided regardless of which cutting of hay is used.

The feed racks for hay and bunks for pulp should be near together so that the steers will have to travel but a few steps in passing from one feed to another.

Cattle seem to be particularly fond of well-cured pulp from the silo, preferring this to fresh pulp. In order to secure the pulp in its best form, it is desirable to have it placed in the silo fresh from the factory and later transferred direct from the silo to the feeding troughs. After fermentation has once begun, exposure to the air in handling causes the pulp to deteriorate rapidly in quality. Cattle relish it less after a continual exposure to the air, and reject a larger per cent than they would in the case of pulp direct from the silo.

On account of the uniform mildness of the weather during the experiment, there was no noticeable variation in the amount of pulp eaten, or resulting gains, that could in any case be attributed to climatic conditions. It is very probable, however, that during a period of severe cold weather, pulp would prove a rather unsatisfactory feed, since it is not in any sense a heat generating food.

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The Agricultural Experiment Station

OF THE

Colorado Agricultural College.

Beet Worms and their Remedies

I. The Beet Web-Worm.

II. The Beet Army-Worm.

By CLARENCE P. GILLETTE.

III. Cutworms.

By S. ARTHUR JOHNSON.

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FORT COLLINS, COLORADO.

THE STATE BOARD OF AGRICULTURE.

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THE BEET WEB-WORM,

Loxostege sticticalis L.

CLARENCE P. GILLETTE.

The beet web-worm did more or less damage in all the beet growing sections of the state last summer and fall. In the vicinity of the Loveland and the Longmont factories very little harm was done but the beets grown for the sugar factories at Rocky Ford, Sugar City, Fort Collins, Windsor, Greeley and Eaton all suffered to a considerable extent in some of the fields.

This insect does not possess any great notoriety as yet as a crop pest. Twelve years ago * last summer it attracted some attention because of its injuries to sugar beets in Nebraska during the months of July and August, and because of its injuries to a field of mint in Michigan late in September. Since 1892 it has not attracted much attention.

For thirteen years at least the moth, which is the adult form of this insect, has been abundant in the vicinity of Fort Collins, where it has been one of the most common of the insects taken at electric lights. In 1897, when Mr. E. S. G. Titus was running a lantern trap for this department, he took this moth in large numbers. The record runs as follows: May 20th, 439 moths; May 22d, 2 moths; May 23d, 191 moths; May 25th, 7 moths; May 29th, 24 moths; May 31st, 31 moths; June 11th, 5 moths; June 16th, 6 moths; June 18th, 57 moths; June 20th, 76 moths; June 25th, 58 moths; Oct. 1st, 1 moth.

From my notes upon captures of this insect in 1897 I quote the following:

May 13, *Loxostege* moths have been very abundant for more than a week flying to the flowers of plum and other fruit trees.

The moths taken May 20 by Mr. Titus are about half males and half females. Dissections of the females show that the eggs are still immature in the great majority of cases.

June 8, The moths are becoming scarce. Some of those taken are full of eggs, while others have nearly finished laying.

June 10, Very few of the moths are coming to light now.

* See article by C. V. Riley in Report of the Department of Agriculture for 1892, p. 172, also article by Riley and Howard in "Insect Life" Vol. V. p. 320; an article in the same publication by L. O. Howard, Vol. VI. p. 399, and an article by Lawrence Bruner in Bulletin 30, U. S. Dep. of Agr., Div. of Entomology.

From my notes of 1896 I extract the following:

May 22. Took about 500 *Loxostege sticticalis* moths last night. Cloudy and warm.

May 24. Took about 200 moths of *L. sticticalis* last night. Examined 100 moths and found that 29 were males and 71 females. The females predominating so greatly indicates that the eggs have quite largely been deposited. Dissections show that the majority of those taken have their ovaries full of eggs; in some cases the eggs are still immature, and in others many or nearly all of the eggs have been deposited.

June 10. The moths are still numerous at light and females are still found containing immature eggs.

These records with others at this station indicate maxima of the broods about the 20th of May, June, July, and August. The records have not been continuous throughout a season, but are sufficient to strongly indicate a brood of moths and worms prior to the brood that attacks the beets in July though no one seems to have discovered the worms of this brood as yet.

HISTORY OF THE WORMS IN COLORADO.

The first complaint of injuries of any importance done by this insect in Colorado that came to my notice was on the 9th of July, 1903, when Mr. H. V. Norton, living a couple of miles northeast of Fort Collins, sent word that some kind of a worm had suddenly appeared in great numbers in one of his fields and was rapidly destroying his onions and cabbages. I visited Mr. Norton's place at once and found near the center of the infested lot a small patch, perhaps a half acre, of dry uncultivated ground above water, that was densely grown up to pigweed (*Chenopodium album*). The weeds appeared to have died and dried up, but upon examination I found that the leaves had been eaten away by the worms of the insect under consideration, and that some of the worms were still upon the plants, but the great proportion of them had migrated out in all directions into the patches of onions and cabbages which were close at hand. The worms were nearly full grown and after a few days disappeared.

Two days later, July 11, I was informed that a little striped worm had appeared in many of the beet fields northeast of Ft. Collins and was doing serious injury to the plants which were still rather small. In company with Mr. Charles Evans, manager of the Ft. Collins Beet Growers Association, I visited several farms where injuries were reported. In most cases the injury was not severe. Where the worms were most numerous, in nearly every case, the field was in alfalfa the previous summer, and considerable alfalfa had been allowed to grow among the beets up to about the time of our visit. Whether the alfalfa had any direct bearing upon the presence of the worms or not is, however, quite uncertain. The late brood of worms which did the chief harm the past season, were not heard from in 1903.

During the last week of June of the past year (1904) word came from Mr. P. K. Blinn, field agent of the Experiment Station, and Mr. W. K. Winterhalter, agriculturist of the American Beet Sugar Co. at Rocky Ford, stating that a worm was troubling the beets in the Arkansas Valley. Mr. S. A. Johnson of this department was sent to investigate the matter. Mr. Johnson did not find the injuries very severe except in small areas in a few fields, and several patches had already been sprayed with Paris green or arsenite of lime in water. Mr. Johnson concluded that the Paris green sprays had given best results, and especially where a second application had been made a few days after the first. A sample of the spraying outfits used, from a photo taken by Mr. Blinn, is shown at Plate II, Fig. 1. Plate II, Fig. 2, shows the work of the worms in one of the fields visited by Mr. Johnson at that time. The writer visited the same locality again Aug. 19th and was much assisted in his investigations by Mr. Winterhalter and Mr. Blinn. At this time the August brood of worms had about completed their work of destruction which exceeded that of the July brood.

The first complaint that came to the experiment station last summer was Aug. 13. On that date I went with Mr. C. M. Liggett to his ranch about 10 miles northeast of Ft. Collins and found the worms doing considerable damage. Occasional moths were still in the field. Mr. Fred Wright, agriculturist for the Ft. Collins factory, told me that the moths were abundant in Mr. Liggett's field ten days before. A week later many other fields were seriously attacked. The worms continued to increase and devastate other fields for fully two weeks, but they had nearly disappeared in Mr. Liggett's field on Aug. 22.

Mr. Timothy, agriculturist for the Greeley sugar factory, told me that he first noticed the worms at Sterling August 3, and at Greeley August 10. The worst of the injuries were over at Greeley August 20. Mr. Johnson was at Sterling August 18 and noted that the injuries were practically over there at that date. He also reported immense flocks of sparrows feeding upon the worms.

FOOD PLANTS.

I have noticed the worms feeding freely upon beets, cabbages, onions, pigweed (*Chenopodium album*), Russian thistle and alfalfa. They will probably feed upon many other plants in case of an emergency.

LOSSES.

Growers have estimated their losses all the way from one to five tons per acre as the result of the injuries by the worms.

Analyses by the chemists at the sugar factory indicate a loss of about 2 per cent. in both sugar content and in purity in beets that were defoliated badly during August. Probably more than 1000 acres of beets suffered substantial loss from the web-worm in Colorado last year.

LIFE AND HABITS OF THE INSECT.

The worms that were in the beet fields last August disappeared by burrowing into the ground to the depth of an inch or two and spinning about themselves white silken tubes from three-fourths of an inch to one and one-half inches in length, and three-sixteenths of an inch in diameter. A few of these worms changed to pupæ and emerged again as moths during September, but nearly all of them have spent the winter as worms in the silken tubes. Mr. G. P. Weldon, a special student in entomology, dug 69 of these tubes from one square foot of ground in a badly infested beet field on Aug. 31. On the same day he opened 111 tubes and found 13 pupæ and 97 worms. He also noted that the moths were quite numerous in the field, more so than a number of days previous. Moths which the writer placed over beets in cages Aug. 25 deposited eggs which began hatching Aug. 31. On September 20, I visited beet fields in the vicinity of Wellington (12 miles northeast of Fort Collins) in company with Mr. Fred Wright, Agriculturist of the Fort Collins Sugar Factory. The worms had disappeared but, although the day was cold, several of the moths were taken and many of the secondary parasites (*M. agilis*) over the beets, but there was no September-brood of worms seen or heard from. Mr. Johnson took a few moths as late as Oct. 12.

Judging from the investigations by Riley and Howard, and Bruner in Nebraska and our own records at Ft. Collins, it is probable that the spring brood of moths will begin hatching about the 10th of May in the beet growing districts of the northern portion of the State, and probably about the first day of May in the Arkansas valley. We have found the moths very numerous at Fort Collins from the 10th to the 25th of May, and it is probable that they are depositing the first brood of eggs at about this time and somewhat earlier in the warmer sections as at Rocky Ford and Sugar City. At this time the beets are not up or are too small to attract the moths so that probably pigweed (*Chenopodium*) alfalfa and other plants that are more advanced serve as food for the early brood. About Sterling, Mr. Johnson noticed that the beets planted after the 25th of June escaped injury from the worms.

The second brood of moths, judging from our records, are most numerous at Ft. Collins, about the last week in June which should give a brood of worms about the 10th of July and this is the brood that did some injury to beets, onions and cabbages near

Ft. Collins in 1903 and about Rocky Ford and Sugar City during the first week of July, 1904. But it was the next, or third (?), brood that did most mischief in Colorado the past year. In the Northern portion of the State the worms were most destructive from the 10th to the 25th of August.

Most moths are on the wing only after dark, or in the twilight, but the moth that lays eggs to produce the beet web-worms is active in the day-time also and may be seen flying about the beets a week or ten days, at least, before the worms appear.

THE EGGS.

The eggs are sometimes deposited singly but usually in clusters or rows of from 2 or 3 to 8 or 10 together. They are oval in form, and about 1 millimeter long by .7 of a millimeter broad (one-twenty-fifth by one-thirty-sixth of an inch), and are quite flat below but strongly convex above. When clustered, the eggs are laid in a row, one overlapping upon another and making an angle of about 45 degrees with the surface of the leaf. In color they are a very pale green with a beautiful pearly reflection. They are deposited upon either the upper or lower surface of the leaves. In our breeding cages the greater number were deposited on the under surface. After once seeing them they are quite readily detected by the naked eye. They are shown once and a half natural size at *a* and *c*, Fig. 2, Plate I. At the end of about the second day there appears a small black speck upon the eggs as shown at *c*. This is the black head of the little worm that is developing within the shell. In about two or three days more the little worm eats a ragged exit hole in one end of the shell and escapes.

THE WORM.

The little worms are almost black at first and so small (one-sixteenth of an inch long) that they are easily overlooked. For the first two or three days the worms eat very little and skeletonize the leaves instead of eating entirely through them, but when they are about half grown and the white stripes begin to show plainly, they begin to eat and grow very rapidly so that the owner of the beets is often made to believe that the worms have migrated in the night from an adjoining crop or field. I have seen no general migrations of the worms except in a few instances where their food supply had given out or become very scanty. A peculiarity of the attacks of this insect in nearly every case that I have observed is that the chief injuries are well in the fields and almost never at the borders. We have also noticed the injuries to be worse in the higher and dryer portions of the fields but we have not found the injuries more common on light than on heavy soil. On individual plants, the young tender leaves at the center were always the last to be eaten.

REMEDIES.

If the worms are numerous enough to attract any attention at all late in the summer or in the fall, the beet ground should be plowed deeply and as soon as possible after the beets are gathered, for the purpose of burying the worms so that the moths will not be able to escape the following spring. If it is impossible to plow in the fall, then the surface of the ground should be thoroughly harrowed or disced for the purpose of crushing the worms and bringing the tubes to the surface where freezing and thawing and the attacks of birds may destroy a large proportion of the worms.

On Feb. 28, 1905, Mr. S. A. Johnson visited a beet field near Ft. Collins that was plowed last fall and collected 94 of the silken tubes on the surface and 76 beneath the surface. The 94 tubes from the surface contained 4 living and 4 dead worms and there were 86 tubes that were empty. The last all had openings in them, some at the end but most of them had been torn open along the side, probably by birds. Riley and Howard in "Insect Life," Vol. 5, P. 321, report Mr. Walter Maxwell, of Schuyler, Nebraska as stating that cocoons that were exposed by repeated harrowings were largely emptied by birds and he mentions particularly meadow larks and quails.

The 76 tubes that Mr. Johnson dug from beneath the surface contained 52 living worms, 13 dead worms and 11 were empty. If we suppose that moths or parasites were hatched from the 11 empty tubes last fall, we should have an indication that about 20 per cent of the worms were killed from mechanical injuries from fall plowing, and a considerable additional number were killed as the result of exposure upon the surface. Those that were deeply covered, it is believed will never find their way out.

If plowing was neglected in the fall, the next best thing will will be to plow as soon as possible after the frost is out of the ground in the spring. After plowing the ground should be thoroughly pulverized and leveled so as to fill in with fine dirt between the clods and prevent the escape of the moths.

It is doubtful if anything farther can be done for this insect before the worms appear upon the beets except to keep the beet fields and surrounding territory as clean as possible of weeds that are attractive to the moths for the deposition of their eggs.

POISONING THE WORMS.

The worms accomplish their work of destruction so quickly that it is important that the beet grower should be prepared to check the injuries as soon as they are seen. In order to do this it will be necessary to be on the look out for the moths which will always appear in the beet fields from one to two weeks before the

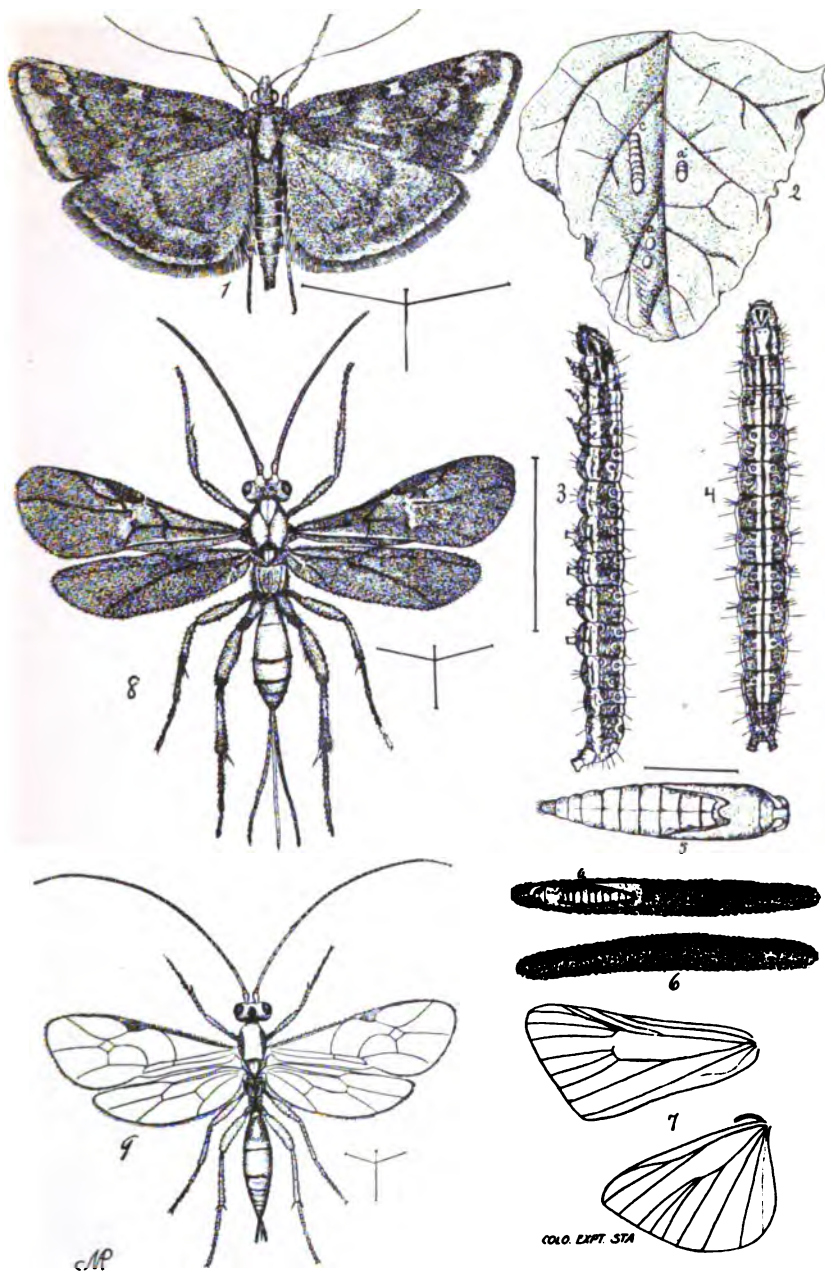
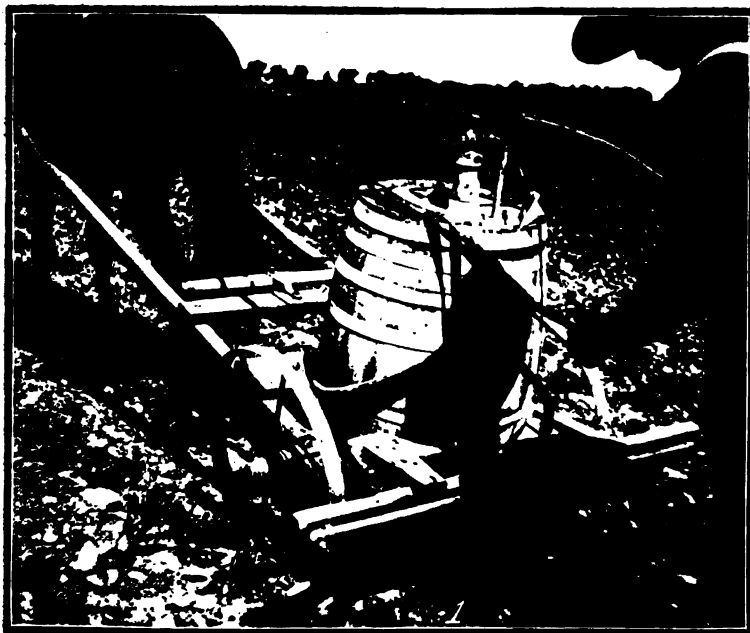


PLATE I.

THE BEET WEB-WORM AND PARASITES.

1. Moth of *Loxostege sticticalis*. 2. Eggs on leaf of beet. 3 and 4. Lateral and dorsal views of larvæ. 5. Pupa. 6. Larvæ tubes from earth. 7. Venation of wings of moth.
8. Parasite *Cremopsis vulgaris*. 9. Parasite *Mesochorus agilis* Cress.

Drawings by Miss Miriam A. Palmer.



COLO. EXPT. STA.

PLATE II.

Fig. 1.—Home-made apparatus for spraying four rows of beets at one time.

Fig. 2.—Beets eaten down by the beet web-worm at Rockyford, Colo., July 4, 1904.

worms will be noticed. These moths span about one inch from tip to tip of their wings when spread and are of a dark grayish or grayish-brown color. (See Plate I Fig. 1.)

They will fly up and go a short distance and then suddenly alight, usually upon a leaf of a plant. The presence of the moths in anything like large numbers among the beets should be the signal to prepare for war by procuring a quantity of poison and a spray pump or some other instrument for the distribution of the poison upon the beet leaves.

THE POISON TO USE.

Some combination of arsenic, as arsenite of lime, arsenate of lead, Paris green, or London purple should be used. The arsenite of lime is the cheapest of these but is a little more troublesome to prepare and apply. Arsenate of lead is more easily mixed and applied but is by far the most expensive poison to use. Paris green settles badly in the barrel or tank and must be kept thoroughly stirred. It would be cheaper than the arsenate of lead but dearer than the arsenite of lime. The chief objection to Paris green last year in Colorado was its serious adulteration with white arsenic causing it to burn foliage. Samples of this poison obtained at Greeley last year, where it was selling for 14 and 15 cents a pound, were badly adulterated which accounts for the low price at which it was sold. A sample of this Paris green was taken to the station chemist, Dr. W. P. Headden, for analysis to determine percentage of arsenic. The report of the analysis was as follows:

"Total Arsenic	-	-	-	60.69 per cent.
Soluble (free) Arsenic	-	-	-	8.51 per cent."

Such Paris green is unfit to use because of its tendency to burn foliage, and it will mix with difficulty with water.

These poisons may be applied dry by means of dust sprayers, or by shaking them through porous cloth sacks (as cheesecloth) carried in the hands, or they may be applied in water by means of force pump and spraying nozzles attached to a barrel or tank. Both of these methods have their strong advocates but after considerable investigation I am convinced thoroughly that the wet spray is much better where it can be used. The principle objection to it is the expense of getting pumps and barrels or tanks necessary to spray large fields. At Plate II, Fig. 1, is illustrated a barrel sprayer mounted on cast off cultivator wheels such as is used by the American Beet Sugar company and by Mr. P. K. Blinn of the Colorado Experiment Station at Rocky Ford. One man with this barrel pump will spray four rows of beets as fast as a horse will walk across the field. The dust sprayers are very inexpensive but all that I have seen used distribute the poison very unevenly over the plants. The dust sprayers have been used quite

extensively about Greeley and many who used them seem well pleased with the results obtained.

PREPARATION OF THE POISONS.

IN WATER.

Paris green or London purple.—Mix one pound of the poison in 50 gallons of water and make a thorough and even application.

Arsenate of lead.—Mix 5 or 6 pounds of the poison in 100 gallons of water and apply thoroughly.

Arsenite of lime.—Boil together white arsenic, lime and water for a full half hour in the following proportions:

White arsenic.....	1 pound
Lump lime.....	2 pounds
Water.....	3 gallons

Then dilute to 100 gallons with water and apply.

Or prepare as follows: Dissolve one pound of white arsenic and 4 pounds of sal-soda by boiling them together for 15 minutes in a gallon of water. Use two quarts of this stock solution to 50 gallons of water and before using stir into it 8 pounds of freshly slaked lime of best quality. Spray thoroughly as with the other poisons.

DRY APPLICATIONS.

About Greeley the past summer the growers used the Paris green dry without any dilution and they applied from 1½ to 3 pounds to the acre. Mr. Timothy, agricultural superintendent of the Greeley Sugar Company, said they had found the dry applications very satisfactory.

Whatever the application, it must be made promptly upon the first appearance of the worms, the poison must be evenly distributed, and the treatment must be thorough, to secure good results.

NATURAL ENEMIES.

Insect-eating birds devour the worms in large quantities. Where the worms were abundant last August the blackbirds were attracted in flocks of thousands and in several instances that came under our observation the worms were all cleaned out of fields by them in the course of two or three days.

Another check which nature has provided to keep this insect from becoming too numerous is a parasitic fly with dusky wings shown in Plate I, Fig. 8, and known to science as *Cremops vulgaris*.§ The large numbers of the worms last year was probably due more to the small numbers of this parasite than to anything

§ Determined for me by Mr. E. S. G. Titus.

else, and if the worms are to be kept down without our efforts, it will probably be chiefly through the attacks upon them by this parasite. Judging from the number of parasites raised in our breeding cages last fall, it would seem that not more than 10 per cent of the worms were destroyed by them last summer. The reason for the small numbers of this friendly parasite we can blame partly, if not entirely, to the presence of another yellow, clear-winged parasitic fly (*Mesochrus agilis* § *Cress.*) shown at Fig. 9, of Plate I, which preys upon the smoky winged parasite of the worms, and so is an enemy of the beet grower. In capturing these parasites over the beets last fall we took almost as many of the clear winged parasite as of the other. This, together with the fact that the worms have passed the winter in good condition makes it seem probable that the worms may appear in large numbers again the coming season but of this we cannot be certain. I would, at least, advise all beet growers in Colorado to be prepared to treat their beets on short notice with some arsenical poison in case the worms should appear.

SUMMARY.

The worms have passed the winter in good condition and the moths will doubtless appear in large numbers about the middle of May.

The May brood of moths will probably lay their eggs upon weeds and other plants and not trouble beets.

If the worms from the May brood of moths succeed in developing well, another large brood of moths may be expected about June 20, from which may be expected the first brood of worms upon the beets, about the first week in July.

Should the July brood of worms meet with no disaster, look for a second brood of worms upon the beets about the middle of August. This brood will probably be more extended than the the others and may appear to consist of two or three broods close together.

The exact time of the appearance of the broods will vary in different portions of the state and with the earliness or lateness of the spring.

Be prepared with poison and spray pump so as to strike the blow in time to prevent serious injury to your beets if the worms should appear.

Where worms have appeared during late summer or fall, always plow the ground deeply before winter if possible and harrow the surface. Failing to do this, plow as soon as possible in the spring and work the surface as finely as possible with disk and harrow.

‡ Determined for me by Dr. L. O. Howard.

Adverse weather conditions or abundance of their enemies may prevent the occurrence, in destructive numbers, of any of the insects mentioned in this bulletin this year, but be on the look out for them.

Whenever insects are troubling your crops, write the Experiment Station for information and send specimens.

THE BEET ARMY-WORM.†

(*Caradrina exigua* Hub.)

This insect might easily be taken for the Beet Web-worm. The moth is a little larger than that species, spanning a trifle more than an inch from tip to tip of wings when spread. The fore wings are quite uniformly grayish brown in color with a pale spot about mid-way near the front margin, and the hind wings are almost pure white except for a narrow strip on the anterior margin which is darker. See Plate III Fig. 1. The worms are also a little larger when fully grown being about an inch and a quarter long. They are also plumper in form, greenish in color and without distinct white stripes, but often with quite distinct dark lateral stripes. See Plate III, Fig. 2.

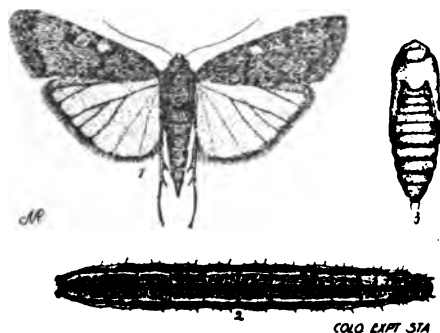


PLATE III.

THE BEET ARMY WORM (*Caradrina exigua*).

1. Adult moth.

2. The Army Worm, dorsal view.

3. Pupa.

The pupa, or chrysalis, is a good half inch long, mahogany brown in color and has two straight slender spines at the small end as shown in Plate III, Fig. 3.

So while these two insects are much alike in general appearance and in the damage they do, they are easily separated in any stage of their development. Their habits are also quite different as we shall see presently.

† This insect was treated in Press Bulletins 1 and 3; Report 12, p. 39; Report 13, p. 128; and Bull., '64; pp. 4 and 10, of this Station.

About the 10th of August, 1899, the worms of this insect seemed suddenly to appear in fields of sugar beets about Grand Junction. Many acres of beets had their tops all eaten away and then the worms turned their attention to the beets themselves eating them out below the crown. Mr. H. H. Griffin, then at Rocky Ford, reported this insect as doing some injury to experimental plats of sugar beets in that locality. Since 1900 this worm has been reported as doing some injury to beets in the Arkansas valley, but it has not been reported in injurious numbers since 1899 at Grand Junction.

LIFE HABITS OF THE INSECT.

The worms that were so numerous in the Grand Valley in 1899, burrowed into the ground to the depth of about an inch when they became full fed, formed an earthen cell about themselves, apparently without spinning any cocoon, and from these cells the moths appeared in great numbers during the latter part of August and September. The moths appeared so late that it seems probable that they hibernate during the winter in that stage, but of this I have no positive knowledge. I was shown injuries done to beets by this worm during June of the same season at Grand Junction, so there are two, and possibly three broods of this insect in a year.

In June 1900 Mr. F. D. Ball visited Rocky Ford where this insect was doing some injury and learned that the worms began hatching about June 1st, and that the moths were noticed in the fields two weeks prior to that date. He also noted that early planted beets suffered most and the application of Paris green had proven a satisfactory remedy*.

The following life history notes are extracted from breeding cage records kept by Mr. Ball upon the development of worms of all sizes taken by him at Las Animas, July 16, 1901, while an assistant in this department:

July 22, 1 chrysalis, (or pupa.)

July 24, another worm in earthen cell ready to pupate.

July 27, several worms have pupated in the last few days.

July 29, all have changed to pupæ.

Aug. 5, first moth emerged.

Aug. 6, another moth.

Aug. 7, another moth and a parasite from July 22, pupa.

Aug. 8 to 14, one to 4 moths each day.

Aug. 9, four moths that hatched today were put in a cage with sweetened water which they ate freely.

Aug. 14, 552 eggs have been laid upon under side of leaves and upon sides of cage. They are in groups of from 12 to 50 and each group is coated with a white downy secretion.

Aug. 15, some of the eggs are looking darker.

*See 18th Annual Report of Colo. Agri. Exp. Sta. p 128.

Aug. 16, half of the eggs are hatched and worms are feeding on leaves. Last night 38 more eggs were laid.

Aug. 17, nearly all of the 552 eggs are hatched.

Aug. 18, 14 more eggs laid last night.

Aug. 21, the eggs laid Aug. 16 have hatched.

Aug. 22, the eggs laid Aug. 18 have mostly hatched.

Aug. 22, 1 male moth dies.

Aug. 24, 100 fresh eggs laid.

Aug. 25, 1 female moth dies.

Aug. 29, another female moth dies. Total eggs laid by the two females, 704. Time from emergence to laying first eggs, 5 days; to laying last egg, 16 days. Time required for eggs to hatch, 4 to 5 days.

The writer was at Palisade, Colo., July 8, 1901, at which time the worms were found in all stages of growth upon beets. The small worms were usually found in groups of from 3 or 4 to 6 or 8 beneath slight webs which they spin for protection. These worms were most common upon the younger central leaves and were more common below than upon the upper surface. The webbing continues with this insect until the worms are nearly grown. In the early stages of the worms they skeletonize the leaves as in the case of the web-worms. Worms taken July 8th at Palisade began changing to pupæ July 14th.

REMEDIES.

When the beets have been gathered it is too late to destroy this insect by cultivation, but a thorough stirring of the surface soil immediately after the worms disappear would probably destroy many of the pupæ in the ground.

The worms may be destroyed by the use of poisons the same as in case of the preceeding species.

CUTWORMS.

BY S. ARTHUR JOHNSON.

Each year farmers and gardeners suffer greater or less loss from the ravages of cutworms. This loss is commonly most severe in the spring or early summer when the crops are just appearing. Injuries occur in midsummer, as well, but they are commonly unnoticed because of the abundance of vegetation. By proper care these may be largely if not entirely prevented. Cutworms are quite generally distributed and in favorable seasons become so numerous that farmers are dismayed at the prospects of losing a crop.

LIFE HISTORY AND HABITS.

Injuries.—The most common and injurious species in this state is peculiar to the Rocky Mountain region, and is figured in the accompanying drawing. In times of great abundance it will travel in immense numbers in search of food, in consequence of which it has been called the "Army Cutworm." An outbreak of this kind occurred in Colorado in the spring of 1903 and is quite fully reported by Prof. Gillette in Bulletin 94 of this Station. During the previous season the moths were unusually abundant. They always fly at night and hide by day among the leaves of trees, in the grass, under boards, or other places of shelter. In the suburbs of Denver they fairly besieged the houses when the lamps were lighted. In a very few minutes after dusk the windows and screen doors would be covered with moths. They crept in by every crack and crevice much to the annoyance of the people who were at times forced to put out the lights and retire to escape the enemy. The insects were noticeably more abundant at houses near alfalfa fields.

Dates of Appearance.—The college records show that this and the closely allied species, *Chorizagrotis agrestis* and *C. introjerens*, appear in two broods, the dates of the spring captures at Fort Collins ranging from April 16th to July 27th, and those in the fall from September 3d to October 12th. These dates, how-

ever, represent only stragglers at either ends of the broods. The greatest abundance of the moths in the spring comes between the middle of May and the first of July and in the fall in the later half of September.

Eggs.—The eggs laid by the fall brood cause the troublesome worms in the spring. The eggs are laid almost exclusively upon vegetation, and, although the worms are very general feeders, they appear to show some preference for particular crops. They are always more or less abundant in fields of alfalfa. Where virgin soil is broken they may usually be found. A significant instance came to our notice two years ago. In a number of cases cutworms were quite destructive to sugar beets where these were planted in ground which bore a crop of barley the previous year.

When the egg is laid it is white in color, hemispherical in shape and attached to the leaves or grass by the flat side. Under the magnifying glass it shows beautiful striations which radiate from the center toward the edge of the disc. Before hatching, which occurs in a very few days, the eggs become brown in color.

Young Worms.—The young worms are very small and travel about for a short time with the looping motion of the measuring worms. They feed during the night and hide by day under some protecting object or in holes which they make in the ground.

Hibernation.—By the time cold weather begins the young are about half grown and range from a half inch to an inch in length. In color they are brownish or greyish with in many cases a distinct greenish tinge. At this time they are provided with three pairs of sharp pointed feet under the forepart of the body and four pairs of blunt prolegs under the posterior part. In this condition the worms spend the winter buried in the ground.

Spring Injuries.—With the warm spring days the worms come to the surface at the time the first blades of grass and leaves appear. Their appetite is now ravenous. Their growth during the fall has been rather slow, but now the size increases by leaps and bounds. At this time of year vegetation is scarce. Most of the green has been killed by the winter's cold, and the young, tender shoots, which give promise of harvest, furnish a most pleasing feast for the hungry worms. Then the seriousness of the pest becomes evident, especially if the field has been recently plowed and seeded or set with plants, in this way reducing the amount of food. In beet fields the worms cut off and devour the seedlings as soon as they appear above the ground, often following along the drill mark and taking everything in the row for several feet.

Full Grown Worms.—The worms are now between one and two inches in length, rather plump and sluggish, and have a habit of curling up when touched or suddenly exposed to the sunlight. The color is dull green or greenish brown. Two broad, irregular stripes extend down the back which are lighter in color than the rest of the body and more brownish. On the sides will also appear broad light colored lines. The number of prolegs is now found to be five pairs. The easiest way to discover the presence of worms in the field is to examine under boards, clods and other objects, or dig in the earth near the base of plants. Often when a plant has been injured the culprit may be found by digging in the ground near it. They seldom bury themselves to a greater depth than two inches.

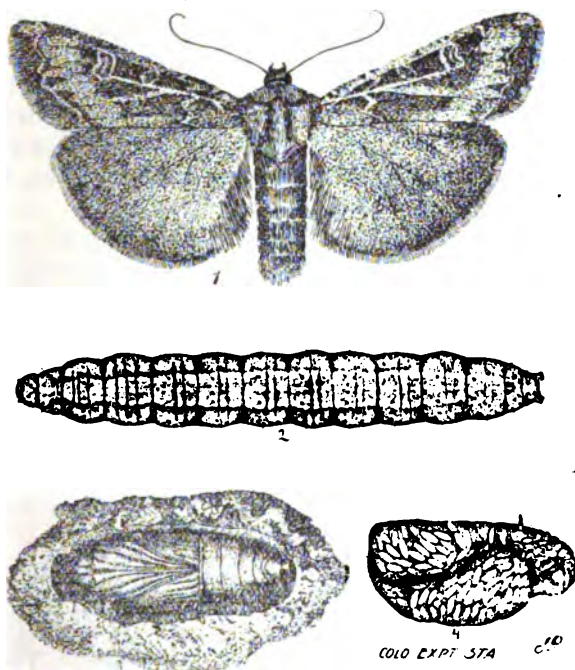


PLATE IV.

THE ARMY CUTWORM. (*Chorizagrotis auxillaris*.)

1. The adult moth. 2. Full-fed larva. 3. Pupa in case of hardened earth.
 4. Cutworm filled with chrysalids of tiny parasite.
- [We have reared as many as 200 of these parasites from one cutworm.]
All twice natural size.

At Aurora, near Denver, in 1903 the larvæ were so abundant that they ate off entire fields of alfalfa. The early garden crops were almost entirely destroyed. The larvæ covered the sidewalks in such numbers that it was impossible to walk without

crushing them under the feet. They crawled in at the doors and became a household pest. Mr. Rauchfuss saved his garden by hunting the worms with a lantern at night. The field injuries were most noticeable in the cases of early sown barley, sugar beets and alfalfa of one year's standing. At Fort Morgan Prof. Gillette found that there were two distinct forms of attack. Where virgin soil had been broken, the larvæ were abundant in all parts of the field and the entire crop in some cases was taken, the young plants being eaten down to some distance below the surface of the ground. In other places where the ground was plowed the previous fall the field itself was not infested, but the worms migrated in from adjoining lands to a distance of several rods denuding the ground as they went. See Plate IV, Fig. 2.

Pupation.—When the larvæ have attained their full growth they make vertical burrows in the ground to the depth of about two inches and change to the chrysalis form with the head of the chrysalis pointed to the opening of the burrow. This change usually takes place in May or early June. Of course injuries cease when this transformation is accomplished. The chrysalis is dark brown and much shorter and more plump than the worm from which it came. See Plate IV, Fig. 3.

The Adult Moths.—The adult moths appear in about a month. They have a ground color of blackish brown. In the species whose life history we have just been over, the front wings are marked with lighter brown. The front and back edges are margined with this and patches occur between these lines. The back wings are lighter than the front and are dusky in color, darkest on the outer margins. The eggs are laid shortly after the moths appear and the summer brood of worms live and produce the fall brood of moths. See Plate IV, Fig. 1.

ENEMIES AND PARASITES.

The rate of increase in cutworms, as in most insects, is enormous, but this is offset commonly by the raids made upon them by their natural enemies. When the parasites fail to keep the insect down, things become serious for the farmer. The enemies may be divided into two classes; those which prey upon the worm, killing and eating it, and those which live within and upon the tissues of the worm, finally killing it.

Vertebrate Enemies.—To the first class belong chickens, birds, ground squirrels and pigs. Under the conditions existing in Colorado, probably the birds are the most useful. Quail, meadowlarks, bluebirds and bluejays are known to feed upon them. The flocks of blackbirds which constantly patrol the fields destroy immense numbers. When a field of alfalfa is flooded

the worms crawl out and are thus exposed, the blackbirds congregate and help to rid the farmer of his hungry foes.

Parasites.—The insects which live within the worms are many in kind and number. The maggots of several kinds of flies attack them. Wasp-like insects, both large and small, help in the good work. Two species of the larger kinds (*Ichneumon longulus* and *Amblyteles subrufus*) have been reared at the Station while the worms at Denver two years ago were very largely parasitized by a tiny insect belonging to the genus *Copidosoma*. Plate IV, Fig. 4. Counts were made from those reared from several worms and gave in individual cases from one to two thousand. So many of the worms were overcome by these agencies that there was no recurrence of the pest.

REMEDIES.

There are two methods by which injuries may be controlled. One is preventive and aims to forestall trouble, and the other tends to lessen losses after the injuries are noticed.

Preventive.—Early fall plowing will almost surely prevent the presence of worms in the field, for it leaves no vegetation on which the eggs may be laid. In the case of alfalfa, plow to the depth of three or four inches in September. This will not only prevent the pest, but will give the young foliage time to rot and furnish nourishment for the young beet. After plowing, harrow or otherwise treat the field so that it will be kept bare until winter sets in.

Late fall plowing is almost equally beneficial for it turns the young worms under so deeply that they seldom come to the surface or else it exposes them in such a way that they fall an easy prey to the watchful birds or the inclement weather.

Clear away all rubbish from the borders of the field. Such collections furnish the best kind of shelter for the worms over winter, from which they may invade the growing crop.

If the field has not been plowed in the fall for any reason, it should be thoroughly examined for the presence of the pest in the spring. This may be done by examining under any object which may be laying on the ground. It would be well to lay bits of board or shingles in different places and look under them every few days for worms.

Alleviative.—If the worms are present in the fields in the spring, they may be almost surely checked by one of the following practices:

Spray heavily with Paris green or other arsenical mixture a growing patch of alfalfa or grass, mow it close to the ground and

spread over the plowed field in small handfuls at a distance of every few feet. The Paris green should be used at the rate of one pound to a hundred gallons of water and the grass distributed late in the day so that it will not wither before the worms attack it at night. Of course ground must be sprayed which will not soon be eaten over by stock. If desirable the poison may be mixed in a barrel of water and the green material dipped into it and then distributed over the ground. The water must be constantly stirred to keep the poison in suspension.

If fresh vegetation is not available arsenic bran mash may be used. This is made by the method used for grasshoppers. The U. S. Department of Agriculture gives the following directions for preparing this insecticide: "Paris green, arsenoid, white arsenic, or in fact any arsenical can be used for poisoning this bait, and in its preparation, on account of the weight of the poison and the fact that it soon sinks to the bottom of the water when stirred, it is best to mix the bran with water and sugar and then add the poison. The proportions are two or three ounces of sugar or a similar quantity of glucose or molasses to a gallon of water and a sufficient amount of bran (about a pound per gallon) to make, when stirred, a mixture that will readily run through the fingers." About one pound of poison should be used for every fifty pounds of bran. Often syrup may be had at the sugar fac-

tories at a very much cheaper rate than the cost of the other sweetening materials. Scatter this preparation over the fields late in the day, preferably when the ground is bare, either before the seed is planted or before it comes up. Dr. John B. Smith is authority for the statement that a field may be cleared in forty-eight hours by this means. If the beets have already begun to come up the bait should be placed in little heaps of a tablespoonful each along the rows.

A dry mash composed of Paris green 1 lb., equal parts of bran and middlings 20 lbs. is recommended by Dr. Forbes.

Either of the bran preparations are dangerous to fowls and these should be kept off the fields for several days.

Bulletin 99.

March, 1905.

The Agricultural Experiment Station

OF THE

Agricultural College of Colorado.

How Can We Maintain the Fertility of Our Colorado Soils?

— BY —

WILLIAM P. HEADDEN.

**PUBLISHED BY THE EXPERIMENT STATION
Fort Collins, Colorado.
1905.**

The Agricultural Experiment Station,

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THE STATE BOARD OF AGRICULTURE.

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HOW CAN WE MAINTAIN THE FERTILITY OF OUR COLORADO SOILS ?

BY WM. P. HEADDEN.

This bulletin has no other purpose than to present to the farmers of Colorado some of the most patent facts relative to the maintenance of the productiveness of their lands. The writer has presented this subject repeatedly, either in lectures before Farmers' Institutes or bulletins, and particularly in the pages of our too short-lived *Agricola Aridus*. The presentation of this subject has, heretofore, apparently failed to attract the attention of our farmers, either because of the unskillful manner in which it has been presented, or because it was not opportune, the farmers not yet having come to a realization of the importance of the question, as one appertaining to their lands and to their prosperity. The time may be more auspicious for obtaining the attention of a reasonable percentage of the persons for whose benefit the Experiment Stations have their existence. It is in hope that this is the fact, that I present the following considerations, and not for the purpose of presenting any new results, or any facts which are not already well known.

OUR COLORADO SOILS ARE NOT INEXHAUSTIBLY RICH.

In the early days of Colorado agriculture, when the railroad land agent was endeavoring to induce homeseekers to settle on our prairie lands, it was, perhaps, pardonable to emphasize their virgin condition and to claim for them inexhaustible fertility. This fiction was soon dispelled by the plain facts, so plain that no one could misunderstand them. The magnificent yields of the first few years after the lands were brought under irrigation, were followed by rapidly decreasing ones, until they fell to one-half or one-third of their former weight or measure, and it became evident to the most obtuse that a remedy had to be found.

That this result would ensue, and that rapidly, was easily to be foreseen; the nature of our soils justified no other belief or expectation, and we now begin to apprehend that in our climate itself we have added reasons for the fact that the virgin fertility of our soils was of comparatively short duration when subjected to continuous cropping without fertilization.

Our soils on the eastern slope of the Rocky mountains are, for the most part, light, sandy loams. The heavier, clayey soils, derived largely from the disintegration of shales, especially of the Ft. Benton shales, are apt to come under the class of soils designated as gumbo, which, to use the language of an earlier writer, is inimical to vegetation. The soils derived from the strata of the Jura-Trias may be somewhat clayey, occasionally limey, due to the presence of calcite or ordinary lime stone, or to the presence of gypsum, the latter mineral being of common occurrence in portions of these strata.

ORIGIN OF OUR SOILS.

The origin of our soils may safely be ascribed to the breaking down of the rocks forming the mountains to the west of us. The mountains from which the material of the strata of the Jura-Trias were derived may not have been the present mountains, but the material composing them is so similar to that yielded by the disintegration of the Front Range, that there is no reason for discussing the possible differences in origin.

The rocks of the mountains are essentially granitic in character, and the sands and soils derived from their disintegration will naturally partake of this character, too. It is a fact that the soils from the foothills to the eastern part of the state are sandy or gravelly loams, in which the sands and gravel are composed of quartz and felspar grains, with some mica plates; in some places they may be coarser than in others, especially in river bottoms they may be finer, but we have everywhere the same general composition with but little variation, and this restricted to small sections.

The base of our soils, mineralogically, is very uniform. The fact that they are nearly all sandy loams tells us that these mineral grains still possess their mineralogical characteristics; they have been broken and ground to small sizes, but they have not been materially changed in their composition. The felspar, hornblende, augite or mica are the same rocks that form the mountain masses, only that they have been broken up into very small pieces. If we examine the red, clayey soils, corresponding to the Jura-Triassic strata, we find the same to hold true to a very great extent. The red sandstones of this formation show the same facts.

Such are the salient, mineralogical characteristics of our soils. The mineral which can furnish the potash is a felspar, orthocluse, which yields slowly to the decomposing action of water and air, and to some extent, to the action of the roots of the plants. The total amount of potash in our soils is from two and one-quarter to two and one-half per cent. of the weight of the soil. A comparatively small portion of this, however, exists at any given time in such form as to be readily taken up by plants. Before this can take place, the

felspar must be altered and the potash brought into another form, or, in other words, it must be prepared for the use of the plant. In our virgin soils, this preparation had, to a certain extent, taken place, but this supply of prepared, available potash was quickly used up, and the magnificent crops of the first few years gave place to poor and unremunerative ones.

The phosphoric acid in our soils is also furnished, certainly in a large measure, by the felspars. A sample of this mineral, just as it was broken from the granite of which it formed a part, contained more phosphoric acid than some of our soils. The amount was below the minimum considered necessary to a fertile soil, but was equal to or greater than the amount found to be present in sixteen out of fifty-five samples of soils representing the different counties of this state.

The same facts pertain to this substance, regarding the extent to which it is prepared to be taken up by the plant, or, as it is generally expressed, its availability, as to the potash.

OUR SOILS NOT RICH IN POTASH AND PHOSPHORIC ACID.

The average Colorado soils, as represented by a considerable number of samples from almost as many portions of the state, are not very rich in these elements of plant food, potash and phosphoric acid; that is, the amount of potash taken up by dilute acids is very moderate indeed, while the total amount of phosphoric acid is comparatively small, only about one-tenth of the samples analyzed showing two-tenths of one per cent. or more, and about one-third of them as much as one-tenth per cent. or more. This statement, unlike the one relative to potash, has reference to the total amount of phosphoric acid present, because dilute acids extract the whole of it from the soil.

THE NITROGEN IN OUR SOILS.

This element may be considered as having been furnished wholly by the agency of animals or plants. It is the most variable plant food in soils in general, depending, also, to a considerable degree, on conditions of climate, which are of less effect in the cases of potash and phosphoric acid. There are the same questions of availability regarding the nitrogen as regarding the other two plant foods mentioned. But assuming that a fairly productive soil contains about one-tenth per cent. of nitrogen, nearly all of our soils would measure up to this standard, but only a comparatively small number of them would have a considerable excess above this, less than one-third of the samples analyzed showing as much as two-tenths per cent. of nitrogen.

The statements made in the preceding paragraphs pertain almost exclusively to virgin soils.

These, then, were the conditions under which our agriculture began. It is a well known fact, that the farmers very soon began to feel the need of doing something to keep up the yield, particularly of the cereals, because this was the first class of crops raised.

THE COST OF GROWING CROPS.

In these early days the soil bore the burden or cost of raising the crops, and the farmer made no estimate of this; even now he seldom takes this factor into account. A ton of alfalfa, perhaps one of his cheaper crops, is charged with the rent of the land, cost of irrigating, cutting and stacking. There is seldom any question as to whether the ton of alfalfa has cost the land any of its fertility or not. The time has already arrived when these questions of cost in soil fertility must be taken into account. I have taken alfalfa because it is our popular forage plant, and very justly so. I shall use figures in this calculation which I published ten years ago, but they are the same facts, just as true as they were then. The cost of the ton of alfalfa in soil fertility will be best understood if we consider it to have been sold off of the ranch. With the ton of alfalfa hay, cut when the plants were in half bloom, there would be sold fifty-five pounds of potash, ten pounds of phosphoric acid, and fifty-two pounds of nitrogen, some of which, however, came from the atmosphere. I do not know how much of it really came from the air and how much from the soil, but I will assume that one-half of it came from each, and we will use the trade values for these substances as given for 1904. The fifty-five pounds of potash, at 5 cents per pound, is worth \$2.75; the phosphoric acid, in cotton seed meal, etc., is quoted at 4 cents, and the 10 pounds in the ton of alfalfa is worth 40 cents. Considering that one-half of the nitrogen is obtained from the soil, we will have 26 pounds of nitrogen to charge against it at 17 cents per pound, or \$4.42, a total cost in soil fertility, which would have cost, bought in the market in 1904, \$7.57. As it may be better understood by some, I will express it as the cost of raising four tons of alfalfa hay per acre, which would be \$30.28.

The sugar beet is a crop which is now grown on a large scale in several sections of the state. The crop harvested in this immediate neighborhood in 1904 was 80,000 tons. What was the money value of the phosphoric acid, potash and nitrogen removed from the soil by this crop at the current prices of these substances, *i. e.*, 4 cents per pound for phosphoric acid, 5 cents per pound for potash, and 17 cents per pound for nitrogen. These are the values adopted by some of the Eastern Experiment Stations and would be too low for our market. The 80,000 tons of beets would contain 331 tons of potash, worth \$31,100; 71 tons of phosphoric acid, worth \$5,680; 160 tons of nitrogen, worth \$54,400; a total of

\$81,180 for the crop, a trifle over one dollar per ton. In other words, had the farmers of this immediate neighborhood who sold their sugar beets to the local factory, been compelled to pay the market prices for the potash, phosphoric acid and nitrogen removed from their lands by the beet roots taken to the factory, it would have cost them \$81,180.

These examples serve thoroughly well to emphasize the fact that there are other items of cost in raising a crop, even of alfalfa, than those previously mentioned, *i. e.*, land rent, labor, etc., and to show that the cost in the diminished fertility of the soil may be a very important item.

Our farmers can no longer afford to treat this subject with indifference or utter neglect, as they have done in years past, and as they do to a considerable extent even at the present time. We have shown that the soils are by no means inexhaustibly rich; even our virgin soils are not. In fact, none of them are more than moderately rich in the essential elements of plant food.

CLIMATE AND FERTILITY.

Our climate does not seem to be especially favorable to the formation of that form of organic matter known as humus, which favors the retention of nitrogen until it can be converted into a form fitted for its taking up and assimilation by the plant. The moderate supply of plant food, our climatic conditions which favor the complete destruction, the burning up of the organic matter in the soil rather than its humification, and every other condition which tends to lessen the fertility of our soils, admonishes us to vigilance in the preservation and enhancement by every means within our power of the intrinsic value of our lands, which is their power to produce.

This view is supported by the experience of ranchmen or farmers throughout Colorado, and while it is in perfect agreement with the theoretical views held regarding the fertility of the soil and its durability, it is simply a plain matter of fact not fully appreciated as yet, but one which is coming to be more and more generally acknowledged, even by the most careless and indifferent.

The necessity of carefully considering this question cannot be too strongly urged upon all classes of our agricultural population. This will undoubtedly seem a self-evident fact, even a trite one, to many persons, but a very little observation of the practices of our farmers will convince any one that it cannot be repeated too often.

CAN WE PROFITABLY REPLACE THE PLANT FOOD REMOVED?

There is a very important question confronting us, *i. e.*, can we, by any available means, restore the plant food removed by our crops, sugar beets, for instance, at such a cost as will permit us to make a

reasonable profit? The question of our being able to maintain the fertility of our lands is one thing, but the question of its cost is another. It is clear that the returns, either in the present or in the immediate future, must not only pay the cost of maintenance of the fertility, but must permit of a profit. It must, in other words, be accomplished in some business way which must be approved by an increased prosperity.

The means at our disposal with which we may endeavor to meet this question are such as other communities possess, but the questions of costs and local conditions, and perhaps methods or practices dependent upon the latter, may prevent us from availing ourselves of some means which, in other places, have been very efficient. I wish that I could emphasize the fact that the Colorado farmer, while he may avail himself of the observation and experience of others, must solve his own agricultural questions, the maintaining of the fertility of his soil and the earning of profits for himself.

Colorado is not a sea-board state and its agriculture cannot look to the products of the sea as a means of restoring the waste of its lands. Among its varied mineral resources there has not as yet been found phosphorite, apatite, or other rock phosphate, or any salt of potash in such quantity as to permit of its use in agriculture; its packing house industry is too small to supply any quantity of waste or by-products nearly adequate to supply the elements of fertility which we are annually using up. Our manufacturing interests are producing no by-products, such as phosphatic slags, to which we can have recourse. In regard to our sources of nitrogenous fertilizers, we are no better off. Our coke industry might be made to yield us some in the form of ammonia salts, our packing industry a little in the form of dried blood and other forms, but these are all insufficient to supply an amount nearly equal to our actual consumption.

CAN WE USE POTASH SALTS?

If we use German or Stassfurt salts as a supply of potash, we must realize from its use a sufficient return to pay for its production, preparation, marketing and delivery to us, together with the profits put on by the producer and dealer, and leave a margin of profit for the farmer who uses it.

Can the Colorado farmer profitably use these? The answer depends upon two things: First, upon the price that he must pay for the potash. This, of course, depends upon the actual cost of the salt, including transportation, and the modesty of the profits realized by all of the interested parties. Second, upon the increased productivity of the soil, considering the total increase in both quantity

and quality of crop, whether it is produced during the season of its application or later.

The writer does not know of any series of experiments showing conclusively that the Colorado farmer can make a profit by using this salt on general crops, and will certainly be pardoned, if he does not find some sympathy, in entertaining a serious doubt regarding the feasibility of our using this salt for maintaining the supply of potash in our Colorado soils.

CAN WE USE SUPERPHOSPHATES AND CHILI-SALTPETRE?

The preceding considerations apply to the questions relative to phosphoric acid, whether it comes from Canadian apatite, or phosphatic rock from Tennessee, South Carolina or Florida. They also apply to nitrogen, whether it is in sodic nitrate from Chili, or in dried blood, meat, etc., from the packing houses of Chicago. I have assumed throughout that the trade would by every means, consistent with a reasonable business procedure, for it is always entitled to a legitimate profit which no one ought to begrudge, endeavor to make the use of such fertilizing materials profitable in order to extend their business.

It, however, seems to me to be a serious question whether we can, with any hope of realizing a profit, look to these means of maintaining or restoring the fertility of our soils, except perhaps in a few special cases as, perhaps, in market gardening in the vicinity of our larger cities.

BETTER PRACTICE REGARDING BARNYARD MANURE.

In the past, even up to within a very few years, not more than three or four years ago, but little or any use was made of the manure accumulating about our towns and the corrals where hundreds of animals had been fed. Within the past year it has been possible for us to find piles of manure five, ten and even twenty years old, which have lain there just as they were piled when the corrals were cleaned out.

At the present time this is one of the most important and, at the same time, available means for the maintenance of the productiveness of our fields, *i. e.*, the careful husbanding of all the products of the farm which can economically be converted into a fertilizer—say into barnyard manure.

Our former practice was, in cases where the alfalfa was fed upon the ranch where it was grown, to neglect the refuse or perhaps haul it out to dump it in some boggy place; if it were sold off of the farm no further account was taken of it—another crop would grow. So little appreciation of this subject, which is of the very greatest importance to the agriculture of this section, has heretofore been evinced, that it has been possible, within the three years last

past, to obtain at the corral a four-horse wagon load of well-rotted manure for a consideration of twenty-five cents. This time is past, it lasted altogether too long.

WHY SAVE THE BARNYARD MANURE?

I intentionally chose alfalfa as an illustration to show that it cost a great deal to raise a crop, which I endeavored to make evident by converting the elements of fertility into their respective money values, which for a four-ton crop of alfalfa, per acre, amounts to \$30.28, assuming that only one-half of the nitrogen present in this amount of alfalfa hay was obtained from the soil. I realize that it is difficult for the average ranchman to appreciate this fact, for it represents money value which he has never had represented in his bank account, nor has he ever seen the materials in mass, nor can he miss them from the place whence they have been taken. They are, nevertheless, no longer there, but have been embodied in the hay and removed with it. There is less plant food by this much in the soil than there was before.

It costs less, not in the labor of plowing and preparing the seed bed, or of irrigating and harvesting, but in soil fertility, to grow a ton of wheat, or oats, or rye straw, still it cannot be grown except at a cost, and after it has grown and produced its crop of grain, it still has a value which is of too much importance to be permitted to, in any degree, go to waste. Thousands of tons of this material are left in the fields where stock has access to eat what it may, but very large quantities of it are removed before the next plowing by the ready means of the match, whereby the nitrogen and the organic matter, both beneficial to our soils, are dissipated in the atmosphere, while the ash constituents would have been far more valuable if applied jointly with the other constituents of the straw. The glow of the burning straw pile is, even in this year of 1905, not an unusual sight. This, too, has been a wanton waste of fertilizing values which the future will teach us to utilize in a rational way.

Cattle feeding in the vicinity of Fort Collins has given place to lamb feeding, at least, to a large extent. The number of lambs which have been or are being fed in this immediate neighborhood during this season, the winter of 1904-1905, is about 250,000 head. In order to get a clear idea of the important bearing of the question of barnyard manure upon our agriculture, I will estimate the manurial value of the voidings of 250,000 sheep, using conventional but conservative data.

First, we will assume the feeding period to be 100 days; second, we will take the daily consumption of alfalfa at three pounds; third, we will assume the manurial value of alfalfa hay to be \$11.90 per ton; fourth, that the voidings of the sheep contain 95 per cent. of the manurial values of the hay; fifth, that no corn has been fed.

On these assumptions, the total weight of hay consumed will be 37,000 tons, with a manurial value of \$431,300. The voidings equal 95 per cent. of this value or \$409,735. I do not mean to say that this full value can be realized or that no losses will occur, but it is a fact that if our community should desire to purchase the amounts of potash, phosphoric acid and nitrogen contained in the voidings of these 250,000 lambs for 100 days, each lamb consuming three pounds of alfalfa per day, it would cost them not less than \$409,735.

Is it feasible to preserve the whole of the voidings? Very nearly all, and the straw, which is still burned in considerable quantities, could be used to good advantage as an absorbent and would thereby be converted into an excellent form for application as a manure. We know that no one man in the community would reap the benefit of this great value, but the community as a whole should. While I have singled out the sheep feeding as an example, the principle applies to every individual, whether he keeps only one horse or a cow, or is a feeder on a large scale. Everyone ought not only to try to preserve and utilize all of the barnyard manure naturally produced on his farm, but he ought to use every practicable means to increase the amount. While this is particularly applicable to the farming districts, it applies in a less degree to the towns and cities as well.

In using barnyard manure which is produced upon the farm, we preserve, in a large measure, the plant food originally present, but we do not add any to the total originally present; on the contrary a little goes off of the farm in various forms—in the increased weight of the lambs, in the case which we have already used as an illustration. The exception to this statement is in the case of the nitrogen, provided alfalfa, clover or pea-vine hay has been fed, when, owing to the fact that these plants obtain a considerable portion of their nitrogen from the air through the agency of certain organisms, we may actually return more than we took away from the soil with the crop.

The use of barnyard manure is preeminently a method of maintaining the fertility of the land, but is in a measure a method of increasing it by improving the conditions of the soil; also by adding organic matter, and in our case by increasing the supply of nitrogen.

GREEN MANURING.

The next best method is probably that of green manuring, and for this purpose we have no better plant than alfalfa. I know that there are some who may think it too big a sacrifice to turn under a good growth of alfalfa for the sake of its manurial effect upon the soil. The writer has a great deal of sympathy with this view, but it is not well supported by any facts which we can produce. There seems to be no plant which could be grown here for this purpose.

Crimson clover is, so far as I have seen, a failure with us; red clover is by no means a pronounced success, though it will grow; pea vines do not make a sufficiently early growth. Some of the vetches might be better, but they, too, are not early enough. Rye might be used if we aimed at adding succulent organic matter, which would easily decay, but would add no nitrogen or other fertilizing substance.

In green manuring we take nothing away from the soil, nor do we use the crop grown for any other purpose, but simply return it to the soil in its succulent and easily fermentable condition, together with the total content of plant food which it has gathered from the soil. The effects produced may be marked, but they are not due to actual addition of plant food, as in the case of the addition of mineral manures, but are due to the availability of the plant food contained in the crop, the effect of the fermenting material upon the soil and probably to the humus substances produced.

I have stated that alfalfa is our best plant for this purpose. It is out of the question to use this plant for this purpose, except in some systems of rotation, which is, under all circumstances, advisable, whether the last crop is to be potatoes or sugar beets. I am not prepared to even suggest what rotation will prove to be most advisable; some of our practical men can work that out in detail.

I fully appreciate the fact that a good plantation of alfalfa which will yield 3 1-2 to 5 tons of alfalfa hay per acre, is a valuable asset on a farm, but some of our people are coming to realize that it is a good thing to plow under, too, though it is not the easiest task to perform, especially when it is in full growth in the spring time.

ALFALFA OUR BEST PLANT TO USE AS A GREEN MANURE.

There are several considerations which lead me to think this the best plant which we possess for this purpose.

Our soils are only fairly rich in nitrogen, and an addition of this element from time to time is very advisable. Alfalfa is an energetic gatherer of this substance, largely from the atmosphere, the young alfalfa shoots being relatively very rich in this element. There are but few plants, even among the legumes, by means of which we can add nitrogen to the soil so cheaply as by means of alfalfa.

Alfalfa is not only an energetic gatherer of nitrogen from the atmosphere, but it is also an energetic gatherer of other plant food from the soil, so much so that a ton of alfalfa hay made from plants cut in May before any blossom buds had appeared, contained about 60 pounds of potash, equivalent to 111 pounds of the pure sulfate of potash, and whose value would be \$3.00 at the price prevailing last year, while the nitrogen in the same would be worth \$8.50, nearly.

EFFECTS OF ALFALFA DUE TO DEEP FEEDING.

I will here digress a little to discuss a fact which I have made rather prominent and one which may seem to some as an objection to the alfalfa. I have stated that the alfalfa plant is an exceptionally heavy feeder, which I have shown to be the case by showing that the market value of the food constituents removed from the soil by one ton of alfalfa hay, assuming one-half of the nitrogen to have been derived from this source, was \$7.57 at the prices which potash, phosphoric acid and nitrogen commanded in 1904. Some persons have before now asked me how it is possible to harmonize this fact with the observed improvement produced by putting land down to alfalfa for a few years.

Both facts are well established, *i. e.*, that a piece of land which once produced 50 bushels of wheat per acre and had been so far exhausted that it would produce only 18 bushels, may be so far restored in its fertility by being put down to alfalfa for a few years as to produce 35, 40 or even more bushels per acre.

In the meantime it is very probable that an average yield of four tons of alfalfa hay has been cut annually. This land was no longer able to produce 50 bushels of wheat per acre, which, with the straw, would require not more than 143 pounds of potash, phosphoric acid and nitrogen taken together, but it would very probably yield four tons of alfalfa hay during the season, which would require 469 pounds of these ingredients. The alfalfa crop of four tons per season removes a trifle over three times as much of these elements of plant food as a fifty bushel crop of wheat, together with its straw, and that from soil which has been so far depleted of its supply of plant food as to no longer yield more than eighteen bushels of wheat.

I would not be too sure that I can fully explain this great difference. It is, however, no less certainly a fact than it is that such land will again produce wheat at a very greatly increased rate after it has been in alfalfa for a few years.

While I may not explain the facts in the case, I will suggest some things which are apparent. The root systems of the two plants are entirely different. The wheat plant has a fibrous system which, under favorable conditions, may penetrate the soil to a depth of four feet, but the conditions obtaining in our soils are not favorable to their attaining this depth. It is a fibrous system, one admirably adapted to gathering sustenance for the plant from rich, mellow ground, especial at no great distance from the surface, but not to penetrate hard soil to more considerable depths.

The four feet mentioned as the maximum depth to which the wheat roots may penetrate, is probably very much deeper than they, in fact, penetrate our soil, unless it be in very exceptional cases.

The alfalfa has a simple tap root system, at the best only

slightly branching, but able, in our soils to attain to a depth of from 9 to 12 feet, even through soil so firm that a pick is necessary in order to remove it. The largest, most branching portion of this root system is at the point of its greatest depth or nearly so. This system is marvelously free from fibrous roots, though under special but easily explained conditions there may be a fair abundance of what may be termed fibrous roots. For our present purpose we may waive the question of the relative ability of these two plants, the wheat and the alfalfa, to obtain food from sources which may yield it slowly or with great reluctance, and simply consider the amount of soil which they respectively lay under tribute, considering that the whole of the soil from the surface to the maximum depth attained by the respective root systems is involved. Using this assumption as our basis, we see that no part of the soil would be laid under a relatively heavier tax by the alfalfa than by the wheat, because the alfalfa feeds to a depth at least three times as great as the wheat plant. Our assumption, however, is not justified by what we know of the roots of the alfalfa, which form a cone-shaped system whose base is from 9 to 12 feet from the surface. The first few feet of the root may consist of a single tap root and cannot possibly come in contact with more than a small fraction of the soil reached by the smaller roots of the deeper portion of the system. The larger portion of the tap root near the surface, even if it is as active in gathering food as any other portion of the root system, can only gather a comparatively small portion of the food used by the plant. This justifies us in using the term so frequently heard, characterizing the alfalfa as a deep feeding plant. These considerations also justify the popular expression that the alfalfa rests the land, meaning, of course, that portion of the soil previously exhausted by the wheat. The correctness of this assertion is not in the least affected by the apparently contradictory fact, that a four ton crop of alfalfa hay removes from the soil a trifle over three times as much plant food as a fifty bushel crop of wheat, including the straw.

There are some interesting facts relative to this question, and while certain reservations ought to be made, we can still, with a fair degree of accuracy, state that the alfalfa obtains its food very largely below the depth to which the wheat root can penetrate. This explanation may not be a complete one, but it answers two questions which are frequently asked: First, Is alfalfa a heavy feeder? To which the answer is, yes. Second, How does it rest the soil? To this we offer the following answer: By feeding below the depth had in mind by the questioner.

EFFECTS OF ALFALFA DUE TO OTHER CAUSES.

We will now turn to some other facts which cannot be omitted

in considering the question of alfalfa as a green manure. Alfalfa is not a plant which can be sown in late summer or early fall with the expectation of obtaining a growth of desirable material to plow under the following spring. We can only use it as a green manure at the end of a rotation in which the alfalfa is one of the crops, and involves a longer rotation than can advisably be used under Eastern conditions, consequently it is necessary to take other factors into the account.

We have assumed that our alfalfa has yielded four tons of hay annually and we have removed from the soil a total of 469 pounds of plant food in the form of potash, phosphoric acid and nitrogen, or 369 pounds, considering that only one-half of the nitrogen came from the soil. The loss in making alfalfa hay ranges from 20 to 66 per cent. ; in other words, a four ton crop of hay gathered, represents, even under the most favorable conditions, five tons cut, not counting the stubble. This ton lost is composed of leaves and the fine stems, portions richer than the average sample of hay in nitrogen and ash constituents, and representing a total of 117 pounds of plant food. This, owing to our practice of irrigating after each cutting, especially after the first and second cuttings, is almost wholly incorporated into the soil, for the moisture will facilitate its decay and the strong stubble will prevent its being washed away to any considerable extent. The stubble proper is not considered in the preceding statement, on account of which we are justified in increasing this amount, 117 pounds, to 150 pounds, which alone is as large an amount of plant food as is required to raise a fifty bushel crop of wheat. It is further to be remembered that, as we have assumed one-half of the nitrogen added came from the air and the rest of the substances from portions of the soil beyond the reach of the wheat plant, the amount of plant food added is practically a clear gain.

So far two important points have accrued to our soil by simply being put down to alfalfa, a practical resting of the surface soil, which would be still further benefited, as I firmly believe, if we could give our alfalfa a cultivating, and, second, by an addition of plant food. These are not the only points which we will gain if at the end of our rotation we turn under a good growth of succulent alfalfa, rich in nitrogen and potash. Our soils need organic matter, but coarse manure or such as has been firmly matted do not readily pass into decay under our conditions, but the green alfalfa ferments easily, exercising a very beneficent influence upon the soil, not only adding its own available plant food, but possibly acting quite vigorously upon the soil itself, greatly improving the mechanical as well as the chemical conditions. Some of our farmers have already discovered that these things are facts and do not hesitate to turn under a fine growth of alfalfa, though some still look upon it as a doubtful practice.

Some other facts at which we have arrived are of interest in this connection, *i. e.*, the actual manurial value of the stubble. On an acre of alfalfa taken to the depth of six inches it is worth, estimated in the same manner that we have estimated the manurial value of the hay, not far from \$20.00 per acre, while the roots below the depth of six inches possess a value of \$16.00, or the stubble and roots together have a value of about \$36.00 per acre. It may be a rather difficult task to turn under a growing crop of alfalfa in middle or late spring, but it is also difficult to correctly estimate the great manurial value of the excellent material thus added to the soil; it is certainly very much in excess of the figures given above.

There is still another respect in which alfalfa is probably our best crop to use as a means of benefiting the soil. It has been intimated, though not explicitly stated, that our soils are often very firm at shallow depths, so much so that it is very probable that scarcely any cultivated plant may be able to reach the greatest depth to which it can and would feed under ordinarily favorable conditions. A good stand of alfalfa, say three years old, will probably have 500,000 plants to the acre, or more than ten plants to the square foot, every one of which penetrates the soil to a depth much greater than the usual feeding depth of such plants as potatoes, beets, wheat, etc. They not only in this way open up the soil to the attack of less vigorous roots, but fill these channels with a supply of plant food, accompanied by a mass of organic matter that by its decay may bring still more plant food into available form.

This subject of preserving and even of increasing the fertility of our soils cannot be too strongly urged upon the attention of our agricultural population.

While our soils contain a large amount of potash in the total, due to the presence of the potash felspar, the amount of the available potash is not extraordinarily large, and that locked up in the felspar is only slowly becoming available, too slowly to replace that removed by crops. Our soils are poor in organic matter and only fairly well provided with nitrogen. Our climate does not favor the formation of humus, nor do our soil conditions as a rule. The best means at our disposal to meet these conditions and to maintain our good yields are, I believe, to husband all the material available for conversion into well-rotted barnyard manure, our alfalfa, all of which should be fed, if possible, on the farm which grows it, being of great value for this purpose. All of the straw, while of itself not of very great value, can be used to good advantage and should be so used.

Our alfalfa is an excellent plant to turn under as a green manure, but owing to facts which are evident to every ranchman, this involves a certain rotation of crops, at the end of which a good, vigorous growth of alfalfa can profitably be added to the soil.

BULLETIN 100

1905.

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FLORA OF COLORADO

BY
P. A. RYDBERG, PH.D.

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PREFACE

It was not the original intention of the Experiment Station to prepare and publish a work on the Flora of Colorado. The conditions of the State, the character of the flora, which is so different from that of the east, forced the necessity of collections and the study of local flora by the botanists of the Agricultural College and Experiment Station from the very first. The economic study of Colorado plants, especially the search for those which might be adapted to arid conditions, increased this necessity. Opportunity was furnished by collections of grasses and forest products for the World's Fair, and occasion was always taken when trips were made for any purpose, to obtain additional specimens. In the course of time the collection became so extensive that unless put in form for publication the time and expense involved would be lost, and the work which had been done would be of little service to us, and of none to the public in general.

Some systematic collection was done by Professor James Cassidy, Professor of Botany (1881-1889), in the intervals of his many duties, up to the time of his death in 1889. His successor, Professor C. S. Crandall, gave much time to the work, especially after the establishment of the experimental grass station in cooperation with the U. S. Department of Agriculture. This afforded occasion and opportunity for trips in search of promising species of native grasses. Subsequent collections, especially of forest products and grasses for the World's Fair in 1893, gave rise to further collecting trips to various parts of the State. Enthusiastic aid was given by Mr. J. H. Cowan, an energetic and promising student, who became Professor of Horticulture and Botany upon the resignation of Professor Crandall, but whose promising career was terminated by death before he had entered upon the active duties of the position. By this time the collection was of considerable size, had been increased by exchanges, and represented much time and expense. A great many calls came for information, and it was at first thought to publish only a list of the plants which were represented in our own collection. The pressing demands and many duties, as well as the lack of facilities, made it difficult for Professor Paddock

to undertake the completion of the work, and this was rendered unnecessary by the fortunate arrangement with the New York Botanical Garden, by which Dr. Rydberg took our collection for naming, and undertook the preparation of the Flora for publication. With the facilities of the Garden and the cordial aid given by Dr. Britton and Dr. Rydberg, and the special knowledge of Rocky Mountain Botany of Dr. Rydberg, it became possible to make this include much more than our own collection, which had been the original idea. The unrivaled and almost exhaustive collections accessible to them, the completeness of the knowledge of Dr. Rydberg, have made this a much more extensive and consequently much more valuable work than was originally designed. It therefore includes the work of nearly all collectors from the earliest times, and may be considered an exhaustive list of the plants at present known in Colorado. The extent of the service may be recognized when it is stated that while our own collection numbered about 1,400 plants, this Flora includes 2,912, a number greater than is known for any other State except California. The amount of work involved in its preparation, supplying keys to the genera and families, and the completeness of the work speak for themselves.

Acknowledgment should also be gratefully given to the State Board of Agriculture, and especially to Hon. P. F. Sharp, President of the Board, without whose assistance, encouragement and financial aid it would not have been possible for the Station to consider the completion and publication of a work of such magnitude. At one time it was proposed to lessen the expense by issuing a part of the edition as a College bulletin at a fixed price, but the Board took the liberal view that the saving would not compensate for the other disadvantages and that the generous friendliness of the State would justify the special effort in putting this at the service of those needing it, and thus the Station is enabled to issue the Flora as one of its bulletin series. It is believed that the publication will be of use to all systematic botanists, to the schools of the State, to those interested in the economic study of Colorado plants, as well as to all those interested in the fascinating Flora of the Plains and Mountains of Colorado. It is a necessary step in the systematic and economic study of our plants.

The preparation of the copy, keys and index has all been assumed by Dr. Rydberg, and also the laborious task of reading the proof. In addition the proof has been read by Professor Paddock and by the undersigned, but in the latter case attention was directed principally to the places and elevations.

L. G. CARPENTER.

INTRODUCTION.

In 1901, Professor L. G. Carpenter wrote to Dr. N. L. Britton, director-in-chief of the New York Botanical Garden, inquiring if anybody connected with the Garden would be willing and had time to complete the determinations of the botanical collections accumulated at the Agricultural College at Fort Collins, especially during the time Professor C. S. Crandall was professor of Botany at that institution. As the author was well acquainted with the flora of the Rocky Mountain region, Dr. Britton referred the matter to him and at the same time gave him permission to undertake the work provided proper arrangements were made. After some correspondence with Professor Carpenter and Professor W. Paddock, such agreements were made as to make it possible not only to undertake this work but also to prepare a catalogue for publication.

The work has taken more time than was expected at first, partly because it had to be done mostly in the spare time from the author's official duties at the museum of the Botanical Garden, and partly because the author could not always secure the help he expected in the more mechanical work of recording the localities. The printing has also been delayed a good deal, and has been interrupted a few times for various reasons, so the work appears in print about a year later than was expected.

The catalogue is mainly based on the collections of the Agricultural College at Fort Collins, mentioned above, and the herbaria at the New York Botanical Garden. Some additional records have been secured from other sources, as for instance, the National Herbarium at Washington, the Gray Herbarium at Harvard University and the herbarium of the College of Pharmacy of the City of New York. The author has also consulted the various publications on the flora of Colorado. The most important of these are:

T. C. Porter and J. M. Coulter, *Synopsis of the Flora of Colorado*; J. M. Coulter, *Manual of the Botany of the Rocky Mountain Region*; T. S. Brandegee, *Flora of South-western Colorado*; Alice Eastwood, *Flora of Denver and Vicinity*; John Torrey's report on E. James' collection in Long's Expedition; Asa Gray's reports on the collections of C. C. Parry, E. Hall and Harbour; Professor E. L. Greene's various publications in *Pittonia*, *Plantae Bakerianae* and *Leaflets*

and the publications of Professors T. S. Brandegee, Aven Nelson and M. E. Jones, Mr. G. E. Osterhout and Miss Alice Eastwood in the Botanical Gazette, Bulletin of the Torrey Botanical Club, Zoe, Erythea and the Proceedings of the California Academy of Sciences.

The author has tried to verify the records referring to Colorado plants given in these publications. Some of these records have been proven erroneous. In some cases the specimens were wrongly determined, in others the stations at which they were collected are not within the present boundaries of the state of Colorado. Of course, all such species have been excluded from this catalogue. The author has also excluded a few more, which he thought should be included in the same category, although he has not been able to prove them erroneously referred to the flora of Colorado, as for instance Californian, Mexican, or Alleghanian species, accredited to Colorado but not to the intervening states. He has also been forced by circumstances to exclude a score or so species recently described from Colorado, but wholly unknown to the author. Not being able to include them in his "keys" and being uncertain whether the descriptions really characterize new and valid species or merely represent redescrptions of old ones, he thought it best to leave them out until more information could be had.

At first it was suggested that a catalogue should be prepared similar to the author's Catalogue of the Flora of Montana and the Yellowstone National Park. After some consultation with Professor Carpenter, it was agreed that the publication would be of more value to the plant lovers of Colorado, if some characterization of the plants could be given. A descriptive botany or so-called manual was out of question. The author would not have time to prepare such a one within a reasonable time and the College did not have funds available to pay for the cost of preparing it. The author had already begun the work on a botany of the whole Rocky Mountain region. He was preparing the "keys" first, leaving the main descriptive work to be done later. Some of these keys were already made, and he hoped to have most of them ready by the time the catalogue was ready to go to print. It would not take much more work to abstract from these keys the parts referring to the Colorado genera and species, than to cite a number of references to descriptions as was done in the Flora of Montana and the Yellowstone National Park. The author showed Professor Carpenter a catalogue prepared in this way, viz., Dr. T. C. Porter's Flora of Pennsylvania. This was taken as a model, except that the locali-

ties as given on the labels should be recorded instead of merely the counties. A gazetteer explaining the localities is given as an appendix. This was partly prepared by the author, but completed, corrected and revised at Fort Collins, principally by Mrs. L. G. Carpenter.

As stated before, the keys were mainly abstracted from those of the author's larger work in preparation, *i. e.*, as far as these were made. As the Manual will be a purely scientific work, the keys are perhaps drawn in a more technical style than desirable in a catalogue to be used principally by the local and the amateur botanists of Colorado and by tourists. To reconstruct the keys would involve too much extra labor. Besides it is hard or rather impossible to use only plain English without losing the fine shades of distinctions which can be expressed by more technical words. For example, the only purely English word for the technical words: "villous," "floccose," "pannose," "tomentose," "tomentulose," etc., is "woolly."

The measurements in the keys are given in the metric system, a system now used by nearly all the scientific departments of the United States Government and of most colleges and universities of this country. In the English system formerly used in descriptive botany, etc., the inch was divided into 12 lines. It is very hard to find a ruler now-a-days with this division, while rulers with the metric system are to be had nearly everywhere. For those unfamiliar with this system, the following comparative table is given. The equivalents are near enough for all practical purposes:

1 mm. = $\frac{1}{16}$ inch.	1 line = 2 mm.
3 mm. = $\frac{3}{16}$ inch.	$\frac{1}{8}$ inch = 3 mm.
1 cm. = $\frac{3}{8}$ inch.	1 inch = 25 mm. or $2\frac{1}{2}$ cm.
5 cm. = 2 inches.	1 span = 1 dm.
1 dm. = 4 inches.	1 foot = 3 dm.
1 m. = 40 inches (nearly) or 3 $\frac{1}{3}$ foot.	1 yard = 9 dm.
	1,000 ft. = 300 m.

The altitudes were also given in meters, but they were changed into feet by the request of Professor Carpenter, who claimed that the people of Colorado, for whom principally the work is prepared, as a rule think of altitudes in feet only. As the United States Land-Office has not as yet adopted the metric system as their standard, the altitudes may just as well be given in feet. This statement is

made to explain why two different standards are used in the same work. The altitudes are those at which the different species grow within the state of Colorado, so far as records show. Many of the plants which grow at an altitude of 14,000 feet in Colorado, grow at sea-level along the arctic coast.

The nomenclature used is in principle agreeing with the so-called American Code adopted at a meeting in Philadelphia, printed in the Bulletin of the Torrey Botanical Club in May, 1904, and submitted to the International Botanical Congress at Vienna last summer, with a few modifications resulting from a compromise with the European botanists. This code as modified is now followed by a majority of the leading systematic botanists in this country. The fundamental principle underlying is that the selection of generic as well as specific names should always be governed by the priority of publication. The European botanists have adopted this principle as far as specific names are concerned, but most of them are not yet willing to apply the same rules to generic names. In the older publications on the Rocky Mountain flora the so-called Kew Rules were adhered to, which after all gave very little consideration to priority. Many of the names in this catalogue will be unfamiliar to some of its users, but in most cases the old names are given as synonyms in *italic* and also in the index. In the index there has been inserted also a few common names not given in the text followed by the equivalent latin generic name in parenthesis. Most of these are local names unknown to the author before they appeared in a recent publication on western botany.

With regard to generic limitations, the author belongs to that radical school which believes in small genera with closely related species rather than in larger ones with a heterogeneous mass of different groups of plants having relatively little relationship to each other. Many of the older genera have therefore been divided. The division of genera as well as species has gone perhaps a little further than many would think advisable, but the author has tried to be consistent in his work.

The author has not published any new species or genera in this work. He has also tried to avoid the publishing of new names or new combinations of names. Anything that had not been published before, the author has endeavored to publish in the Bulletin of the Torrey Botanical Club while the catalogue was being set in type. The reasons for so doing are the following: (1) The publication of technical descriptions should be limited to technical books and peri-

odicals; (2) in this catalogue there could not very well be given a fuller synonymy with citations of places of publication, nor fuller discussions, which are always desirable and often necessary for clearness sake; (3) if the diagnoses of new species had been interpolated here and there, the uniformity of the catalogue would have suffered.

As it is, the Flora is the result of much labor and stands as a brief index of the present knowledge of the flora of the state. In its present form, the author hopes that it will be valuable for the purpose for which it was prepared, viz., as a record of the higher vegetation of the state of Colorado as far as known to-day and as a guide and help to those interested in its flora. Whatever shortcomings there may be, the author hopes will be forgiven. The technical systematist will undoubtedly find many facts omitted which he would expect to find in a "Flora of Colorado."

From the summary given after the catalogue it can be seen that the higher vegetation (fernworts and flowering plants) of Colorado comprises over 700 genera and 2,900 species, a number surpassed only by California and perhaps by Florida out of all states in the Union. The largest families are *Carduaceæ* or the Composites proper, with 568 species or about 19½% of the flora; *Poaceæ* or grasses, 267 species or 9%; *Fabaceæ* or Pea Family, 185 or 6⅓%; *Brassicaceæ* 144, *Rhinanthaceæ* 106, *Cyperaceæ* 101, *Polygonaceæ* 94, *Ranunculaceæ* 92, and *Rosaceæ* 89 species, or between 3% and 4%, etc. Just as remarkable as the large number of species of Composites (about ⅓ of the whole flora), is the small number of Pteridophytes. The ferns proper are only 25, to which are to be added 15 other fernworts. The same may be said of the Gymnosperms, only 20 in number.

The author has had the help of several specialists in certain groups. Professor L. M. Underwood has prepared the manuscript of the PTERIDOPHYTA, and Mr. H. D. House that of the family *Violaceæ*. Mr. G. V. Nash has given valuable assistance in the grasses. The account of the *Polygonaceæ* was written in conjunction with Dr. J. K. Small. Dr. Theodor Holm has characterized the groups and species of *Carex* and listed the specimens of that genus, while the author prepared the key to the groups. Mr. S. H. Burnham, Mr. H. D. House and Mr. W. W. Eggleston have assisted in listing the localities and Mrs. William Mitchell in copying the keys.

P. A. RYDBERG.

NEW YORK BOTANICAL GARDEN,
NEW YORK, March, 1906.

KEY TO THE ORDERS.

Subkingdom **PTERIDOPHYTA.**

Plants without flowers or seeds, but producing spores each of which, on germination, develops into a flat or an irregular prothallium. The prothallia bear the reproductive organs (antheridia and archegonia). As a result of the fertilization of an egg in the archegonium by a sperm produced in the antheridium a fern or an allied plant is developed.

	PAGE.
Leaves broad entire or dissected. (Fern-like plants.)	
Spores of one kind, minute, borne in sporangia.	
Vernation straight or inclined; eusporangiate, the sporangia ringless, leathery, opening by a transverse slit, arranged in spikes or panicles.	
Order 1. OPHIOGLOSSALES.	1
Vernation circinate; leptosporangiate, the sporangia membranous, provided with a ring which opens elastically.	
Order 2. FILICALES.	1
Spores of two kinds, minute microspores and larger macrospores, borne in sporocarps; leaves filiform or quadrifoliate.	
Order 3. SALVINIALES.	5
Leaves scale-like or awl-like. (Moss-like or rush-like plants.)	
Sporangia in an apical cone, borne under peltate scales: stems hollow, rush-like.	
Order 4. EQUISETALES.	5
Sporangia in the axils of small or leaf-like bracts: stems solid.	
Leaves awl-like, often much elongated, borne on a short corm-like caudex: aquatic plants.	
Order 5. ISORTALES.	5
Leaves narrow or scale-like, flat, borne on erect or creeping stems: terrestrial plants.	
Order 6. LYCOPODIALES.	6

Subkingdom **SPERMATOPHYTA.**

Plants with flowers which produce seeds. Microspores (pollen-grains) borne in microsporangia (anther-sacs) develop each into a tubular prothallium; a macrospore (embryo-sac) develops a minute prothallium, and together with the macrosporangium (ovule) in which it is contained, ripens into a seed.

Ovules and seeds borne on the face of a bract or a scale: stigmas wanting.	
Class 1. GYMNOSPERMÆ.	7
Ovules and seeds in a closed cavity (ovary): stigmas present.	
Class 2. ANGIOSPERMÆ.	11
1. Gymnospermæ.	
Staminate and pistillate flowers both in aments; perianth none; trees or shrubs with needle- or scale-like leaves.	
Order 7. PINALES.	7
Staminate flowers in aments; pistillate ones single or in pairs; perianth present, urnshaped; ours horsetail-like shrubs with jointed branches and leaves reduced to sheathing scales.	
Order 8. GNETALES.	10

2. Angiosperme.

Cotyledon 1: stem endogenous.	Subclass 1. MONOCOTYLEDONES.	11
Cotyledons normally 2: stem exogenous (with rare exceptions).	Subclass 2. DICOTYLEDONES.	91

1. MONOCOTYLEDONES.

Perianth rudimentary or degenerate, its members often bristles or mere scales, not corolla-like, or wanting.		
Flowers not in the axils of dry or chaffy bracts (scales or glumes).		
Perianth of bristles or chaffy scales.	Order 9. PANDANALES.	11
Perianth fleshy or herbaceous, or wanting.		
Fruit baccate; endosperm present.	Order 14. ARALES.	74
Fruit drupaceous; endosperm wanting.	Order 10. NAIADALES.	12
Flowers in the axils of dry or chaffy, usually imbricated, bracts (scales or glumes).	Order 13. POALES.	15
Perianth of 2 distinct series, the inner series usually corolloid.		
Gynœcium of distinct carpels.	Order 11. ALISMALES.	13
Gynœcium of united carpels.		
Endosperm mealy.	Order 15. XYRIDALES.	75
Endosperm fleshy, horny or cartilaginous.		
Ovary and fruit superior.	Order 16. LILIALES.	76
Ovary and fruit wholly inferior or half-inferior.		
Endosperm present and usually copious; flowers regular; andrœcium not reduced.	Order 17. AMARYLLIDALES.	86
Endosperm wanting.		
Flowers regular, monœcious or dioecious: aquatic plants.		
	Order 12. HYDROCHARITALES.	15
Flowers irregular, perfect: terrestrial or epiphytic plants.		
	Order 18. ORCHIDALES.	87

2. DICOTYLEDONES.

A. Corolla wanting.		
I. Calyx wanting, at least in the staminate flowers.		
Herbs.	Order 30. EUPHORBIALES.	221
Trees or shrubs.		
Fruit 1-seeded: seeds without tufts of hairs.		
Fruit a nut or an achene.	Corylaceæ in Order 20. FAGALES.	96
Fruit a drupe or a samara.	Oleaceæ in Order 41. OLEALES.	264
Fruit many-seeded: seeds each with a tuft of hairs.		
	Order 19. SALICALES.	91
II. Calyx present at least in the staminate or in the perfect flowers.		
1. Flowers, at least the staminate, in amentæ, or ament-like spikes; fruit a nut or an achene.	Order 20. FAGALES.	96
2. Flowers, at least the staminate, not in aments.		
a. Ovary superior.		
Gynœcium of 1 or several and distinct carpels: stigma and style of each solitary.		
Carpel solitary.		
Ovary neither enclosed nor seated in a hypanthium or a calyx-tube.		
Flowers not solitary in the axils of the leaves; land plants.		
	Urticacæ in Order 21. URTICALES.	99
Flowers solitary in the axils of the leaves; aquatic plants.		
	Ceratophyllacæ in Order 25. RANALES.	134
Ovary enclosed in or seated in a hypanthium or a calyx-tube.		
Stamens borne under the gynœcium.		
	Allioniaceæ in Order 24. CHENOPODIALES.	122
Stamens borne on the hypanthium or adnate to the calyx-tube.	Order 36. THYMELALES.	239
Carpels several.		

- Stamens inserted below the ovary.
 Families in Order 25. RANALES. 134
- Stamens inserted on the edge of a cup-shaped hypanthium.
 Families in Order 27. ROSALES. 169
- Gynœcium of 2 or several united carpels; stigmas or styles 2 or several.
 Ovary, by abortion, 1-celled and 1-ovuled.
 Leaves with sheathing stipules (ocreae).
 Order 23. POLYGONALES. 101
- Leaves estipulate, or if stipules are present they are not sheathing.
 Trees or shrubs; ovary not seated in a hypanthium.
 Ulmaceæ in Order 21. URTICALES. 100
- Herbs or vines.
 Stipules herbaceous: inflorescence spicate or racemose: leaf-blades palmately veined.
 Cannabinaceæ in Order 21. URTICALES. 100
- Stipules scarious or hyaline or none; inflorescence cymose: leaf-blades pinnately veined.
 Families in Order 24. CHENOPODIALES. 113
- Ovary several-celled, or with several placenta, several-ovuled.
 Stamens hypogynous, inserted under the gynœcium in the perfect flowers, not on a disk in the pistillate flowers.
 Flowers perfect.
 Stamens not tetradynamous.
 Stamens 2; inflorescence spicate.
Besseyia in Order 44. POLEMONIALES. 313
- Stamens 3-10; inflorescence cymose.
 Order 24. CHENOPODIALES. 113
- Stamens tetradynamous.
 Brassicaceæ in Order 26. PAPAVERALES. 150
- Flowers monœcious or diœcious.
 Euphorbiaceæ in Order 30. EUPHORBIALES. 222
- Stamens perigynous or epigynous, inserted on the margin of a hypanthium or a disk.
 Fruit a samara. Aceraceæ in Order 31. SAPINDALES. 226
- Fruit drupe-like or berry-like. Order 32. RHAMNALES. 227
- b. Ovary inferior.
 Flowers not in involucrate heads.
 Fruit a berry or a drupe, or nut-like.
 Stamens as many as the perianth-members and alternate with them, or fewer.
 Tetragoniaceæ in Order 24. CHENOPODIALES. 124
- Stamens as many as the perianth-members and opposite them, or twice as many. Families in Order 37. MYRTALES. 240
- Fruit a capsule.
 Sepals as many as the ovary-cavities or one-half as many.
 Order 37. MYRTALES. 240
- Sepals (4-5) at least twice as many as the ovary-cavities.
 Styles 2-3; leaves alternate.
 Saxifragaceæ in Order 27. ROSALES. 170
- Styles solitary; leaves opposite.
Glaux in Order 40. PRIMULALES. 264
- Flowers, at least the staminate, in involucrate heads.
 Ambrosiaceæ in Order 49. CARDUALES. 327
- B. Corolla present.
 I. Petals distinct, at least at the base.
 1. Carpels solitary, or several and distinct, or united only at the base.
 Stamens at the base of the receptacle, i. e., hypogynous.

KEY TO THE ORDERS.

- Plants with relatively firm stems and leaves, not succulent.
 Order 25. RANALES. 134
- Plants with succulent stems and leaves.
 Crassulaceæ in Order 27. ROSALES. 169
- Stamens on the margin of a hypanthium (the hypanthium very small in some Saxifragaceæ).
 Order 27. ROSALES. 169
2. Carpels several and united.
- a. Ovary superior.
- † Stamens inserted at the base of the ovary or receptacle.
- § Stamens numerous.
- Sepals imbricated.
- Calyx deciduous. Order 26. PAPAVERALES. 148
- Calyx persistent.
- Styles or stigmas distinct or united, but not discoid; land plants. Capparidaceæ in Order 26. PAPAVERALES. 168
- Styles or stigmas united into a disk; aquatic plants; petals and sepals numerous.
- Nymphæaceæ in Order 25. RANALES. 147
- Sepals valvate; stamens with united filaments.
- Order 33. MALVALES. 229
- §§ Stamens few, not over twice as many as the petals.
- Stamens as many as the petals and opposite them.
- Anther-sacs opening by hinged valves.
- Berberidaceæ in Order 25. RANALES. 148
- Anther-sacs opening by slits.
- Flowers monœcious. Order 30. EUPHORBIALES. 221
- Flowers perfect.
- Portulacaceæ in Order 24. CHENOPODIALES. 125
- Stamens as many as the petals and alternate with them, or more, sometimes twice as many.
- Stamens 6: petals 4: sepals 2 or 4.
- Families in Order 26. PAPAVERALES. 148
- Stamens, petals and sepals of the same number, or stamens more, usually twice as many as the sepals or petals.
- Ovary 1-celled.
- Ovules, or seeds, on basal or central placenta.
- Families in Order 24. CHENOPODIALES. 113
- Ovules, or seeds, on parietal placenta.
- Stamens with united filaments and no staminodia.
- Order 33. MALVALES. 229
- Stamens with distinct filaments.
- Staminodia present.
- Parnassiaceæ in Order 27. ROSALES. 175
- Staminodia wanting.
- Families in Order 34. HYPERICALES. 231
- Ovary several-celled.
- Stamens adnate to the gynœcium.
- Asclepiadaceæ in Order 43. ASCLEPIADALES. 270
- Stamens not adnate to the gynœcium.
- Stamens with wholly or partly united filaments.
- Anthers opening lengthwise.
- Families in Order 28. GERANIALES. 217
- Anthers opening by pores.
- Order 29. POLYGALALES. 221
- Stamens with distinct filaments.
- Anthers opening by pores.
- Families in Order 39. ERICALES. 258
- Anthers opening by slits.
- Stigmas or styles distinct and cleft, or foliaceous, or united by pairs. Order 30. EUPHORBIALES. 221
- Stigmas or styles all distinct or all united, neither cleft nor foliaceous.

KEY TO THE ORDERS.

xxi

- Stamens 2. Order 41. OLEALES. 264
- Stamens more than 2.
 - Ovule solitary in each carpel.
 - Styles distinct; ovule pendulous.
 - Families in Order 28. GERANIALES. 217
 - Styles united; ovule erect or ascending.
 - Limnanthaceæ in Order 31. SAPINDALES. 225
 - Ovules 2 or more in each carpel.
 - Order 34. HYPERICALES. 231
- †† Stamens inserted on the margin of a disk or hypanthium (perigynous or hypogynous).
 - Stamens as many as the petals and opposite them.
 - Styles and upper part of the ovaries distinct; ovules and seeds many.
 - Saxifragaceæ in Order 27. ROSALES. 170
 - Styles united, ovules and seeds solitary or 2.
 - Order 32. RHAMNALES. 227
 - Stamens as many as the petals and alternate with them, or more.
 - Styles distinct; upper part of the ovaries distinct, at least at maturity.
 - Saxifragaceæ in Order 27. ROSALES. 170
 - Styles united.
 - Hypanthium flat or obsolete: disk fleshy.
 - Plants without secreting glands in the bark.
 - Order 31. SAPINDALES. 225
 - Plants with secreting glands in the bark.
 - Rutaceæ in Order 28. GERANIALES. 221
 - Hypanthium cup-shaped or campanulate: disk obsolete or inconspicuous.
 - Order 37. MYRTALES. 240
 - b. Ovary inferior.
 - Stamens numerous.
 - Hypanthium not produced beyond the ovary.
 - Ovary partly inferior.
 - Hydrangiaceæ in Order 27. ROSALES. 170
 - Ovary wholly inferior.
 - Order 35. OPUNTIALES. 234
 - Hypanthium produced beyond the ovary.
 - Families in Order 37. MYRTALES. 240
 - Stamens not more than twice as many as the petals.
 - Styles wanting; stigmas sessile.
 - Gunneraceæ in Order 37. MYRTALES. 248
 - Styles present.
 - Styles distinct.
 - Ovules several in each cavity of the ovary; fruit a capsule or a fleshy many-seeded berry.
 - Fruit, if dehiscent, valvate.
 - Families in Order 27. ROSALES. 169
 - Fruit circumscissile.
 - Portulacaceæ in Order 24. CHENOPODIALES. 125
 - Ovules solitary in each cavity of the ovary; fruit a drupe or 2-5 more or less united achenes.
 - Order 38. UMBELLALES. 249
 - Styles united, or single.
 - Plants without tendrils.
 - Ovary enclosed in or surpassed by the hypanthium or adnate to it.
 - Ovules solitary in each cavity of the ovary.
 - Order 38. UMBELLALES. 249
 - Ovules several in each cavity.
 - Ovary with parietal placenta.
 - Loasaceæ in Order 35. OPUNTIALES. 234
 - Ovary with central or basal placenta.
 - Families in Order 37. MYRTALES. 240
 - Ovary exceeding the hypanthium, the top free.
 - Hydrangiaceæ in Order 27. ROSALES. 175

- Plants with tendrils; fruit a pepo; leaf-blades palmately veined. Cucurbitaceæ in Order 47. CAMPANULALES. 325
- II. Petals more or less united.
- Ovary superior.
- Stamens free from the corolla.
- Gynœcium of a single carpel. Families in Order 27. ROSALES. 169
- Gynœcium of several united carpels.
- Filaments united.
- Stamens diadelphous. Fumariaceæ in Order 26. PAPAVERALES. 149
- Stamens monadelphous.
- Anther-sacs opening by slits. Oxalidaceæ in Order 28. GERANIALES. 220
- Anther-sacs opening by pores.
- Calyx and corolla very irregular. Order 29. POLYGALALES. 221
- Calyx and corolla regular. Families in Order 39. ERICALES. 258
- Filaments distinct. Families in Order 39. ERICALES. 258
- Stamens partially adnate to the corolla.
- Stamens as many as the lobes of the corolla and opposite them, or twice as many or more; ovary 1-celled; placenta central or basal. Order 40. PRIMULALES. 261
- Stamens as many as the lobes of the corolla and alternate with them, or fewer.
- Corolla not scarious, veiny; fruit various, but not a pyxis.
- Carpels distinct, except sometimes at the apex. Order 43. ASCLEPIADALES. 269
- Carpels united.
- Ovary 1-celled, with central placenta. Order 42. GENTIANALES. 264
- Ovary 2-3-celled, or falsely 4-celled, or if 1-celled with parietal placenta. Order 44. POLEMONIALES. 271
- Corolla scarious, veinless; fruit a pyxis. Order 45. PLANTAGINALES. 320
- Ovary inferior.
- Stamens with the filaments free from the corolla.
- Stamens 10; anther-sacs opening by terminal pores or chinks. Vacciniaceæ in Order 39. ERICALES. 260
- Stamens 5 or fewer; anther-sacs opening by longitudinal slits. Order 47. CAMPANULALES. 325
- Stamens adnate to the corolla.
- Ovary with 2-many fertile cavities and 2-many ovules; calyx unmodified, at least not a pappus.
- Plants tendril-bearing. Cucurbitaceæ in Order 47. CAMPANULALES. 325
- Plants not tendril-bearing.
- Ovules mostly on basal placenta; plants parasitic. Order 22. SANTALALES. 100
- Ovules variously borne, but not on a basal placenta; plants not parasitic. Order 46. RUBIALES. 321
- Ovary with one fertile cavity.
- Flowers not in heads, often in head-like spikes or racemes. Order 48. VALERIANALES. 326
- Flowers in involucrate heads. Order 49. CARDUALES. 327

FLORA OF COLORADO.

Subkingdom PTERIDOPHYTA. FERN-WORTS.

Order 1. OPHIOGLOSSALES.

Family 1. OPHIOGLOSSACEAE Presl. ADDER'S-TONGUE FAMILY.

1. BOTRYCHIUM Sw. MOONWORT.

Plant large, the sterile leaf ternately decompound, sessile at the middle of the stem.

1. *B. virginianum*.

Plant small; the leaf under 5 cm. long.

Leaf triangular, sessile near the top of the stem.

2. *B. lanceolatum*.

Leaf oval, slightly stalked from near the middle of the stem or lower.

3. *B. Lunaria*.

1. *Botrychium virginianum* (L.) Sw. Rich woods, N. S. to Labr., B. C. and Wash. to Texas and Fla.—Arkansas Cañon (*Brandegee*).

2. *Botrychium lanceolatum* (S. G. Gmel.) Angs. In woods, N. J. and N. S. to Alaska and Wash.—“Colorado.”

3. *Botrychium Lunaria* (L.) Sw. In open places, Newf. to Alaska and Utah: rare.—Alt. about 12,000 ft.—Gray's Peak.

Order 2. FILICALES.

Family 2. POLYPODIACEAE R. Br. FERN FAMILY.

Sori round, or at least less than twice as long as broad.

Sori naked.

Leaves jointed to the rootstock, simply pinnate.

1. *POLYPODIUM*.

Leaves continuous with the rootstock, ternately compound.

2. *PHEGopteris*.

Sori covered with a membranous indusium when young.

Indusium superior.

Indusium circular fixed by the center.

3. *POLYSTICHUM*.

Indusium heart-shaped or reniform fixed by the sinus.

4. *DRYopteris*.

Indusium inferior or lateral.

Indusium inferior, breaking at maturity into stellate lobes.

5. *WOODSIA*.

Indusium lateral, thrown back at maturity like a delicate hood.

6. *FILIX*.

2 POLYPODIACEAE.

Sori linear or oblong, at least twice as long as broad.

Sori marginal.

Indusium present formed of the recurved leaf margin.

Indusium double, the inner membranous one opening outwardly; leaves large, scattered. 7. *PTERIDIUM*.

Indusium single.

Leaves dimorphous, the sporophylls contracted and more or less pod-like. 8. *CRYPTOGRAMMA*.

Leaves uniform or nearly so.

Leaves chaffy or tomentose, the ultimate segments small and bead-like. 9. *CHEILANTHES*.

Leaves smooth with dark polished stalks; segments broader. 10. *PELLAEA*.

Indusium wanting; under surface (in the Colorado species) with white powder; rachises zigzag. 11. *NORTHOLAENA*.

Sori dorsal, oblique to the midribs or rachises, covered with a special indusium.

Leaves pinnate or pinnately compound.

Sori straight. 12. *ASPLENIUM*.

Sori curved, often crossing the veins; indusia occasionally horseshoe-shaped. 13. *ATHYRIUM*.

Leaves dichotomous, the divisions few and narrow; small rock-loving plants of the mountains. 14. *BELVISIA*.

1. *POLYPODIUM* L. POLYPODY.

1. *Polypodium hesperium* Maxon. [*P. vulgare* of western botanists.] On rocks, Mont. to B. C., Wash., Colo. and Ariz.—Alt. about 8500 ft.—Red Mountain road, south of Ouray.

2. *PHEGopteris* Fee. BEECH-FERN.

1. *Phegopteris Dryopteris* (L.) Fee. In moist-rocky places; Newf. to Alaska, Ore., Colo. and Va.—Alt. about 8000 ft.—Green Mountain Falls.

3. *POLYSTICHUM* Roth. HOLLY-FERN.

1. *Polystichum Lonchitis* (L.) Roth. On rocks, Arctic America to N. S., Calif. and Colo.—Alt. 8500-10,000 ft.—Ruby; Red Mountain road, south of Ouray; Fish Creek Falls, Routt Co.

4. *DRYopteris* Adans. MALE-FERN, WOOD-FERN.

1. *Dryopteris Filix-mas* (L.) Schott. On rocks, N. S. to northern Mich., Alaska, Calif., Ariz. and Colo.—Alt. 6000-8500 ft.—Red Mountain road, south of Ouray; Horsetooth Mountain; Cañon City; Rist Cañon.

5. *WOODSIA* R. Br.

Teeth of young leaves coarse, not ciliate.

Stalks and pinnules covered with minute flattened hairs.

Stalks and pinnules smooth.

Teeth of young leaves fine, ciliate at the tips.

1. *W. scopulina*.

2. *W. oregana*.

3. *W. mexicana*.

1. *Woodsia scopulina* D. C. Eaton. On exposed rocks, Mich. to B. C., Calif., Ariz. and Colo.—Alt. 5000-7000 ft.—North Cheyenne Cañon; vicinity of Arthur's Rock; Boulder; Horsetooth Gulch; gulch west of Soldier Cañon; foot-hills, Larimer Co.; South Boulder Cañon.

2. *Woodsia oregana* D. C. Eaton. On exposed rocks, northern Mich. to B. C., Calif., Ariz. and Neb.—Alt. 4000–11,500 ft.—Hills about Box Cañon, west of Ouray; Red Mountain road, south of Ouray; Cheyenne Cañon; Horsetooth Mountain; North Cheyenne Cañon; hills south of La Veta; Parlin, Gunnison Co.; Alpine Tunnel.

3. *Woodsia mexicana* Fee. Foot-hills from Colo. and Ariz. to Mex.—Alt. 7500–9500 ft.—Manitou; South Cheyenne Cañon; Colorado Springs; Cheyenne Mountain; Ouray.

6. *FILIX* Adans. BLADDER-FERN.

Leaves ovate-lanceolate, 2–3-pinnate.
Leaves broadly triangular, 3–4-pinnate.

1. *F. fragilis*.
2. *F. montana*.

1. *Filix fragilis* (L.) Underw. [*Cystopteris fragilis* Bernh.] On moist rocks, Newf. and Labr. to Alaska, Calif., Ariz. and Ga.—Alt. 5000–13,000 ft.—Horsetooth Mountain; Crystal Creek; near Ouray; Red Mountain, south of Ouray; Upper La Plata River; near Pagosa Peak; Cheyenne Cañon; Steamboat Springs; Minnehaha; Sierra Blanca; gulch west of Bear River; Parlin, Gunnison Co.; Lake City; Pike's Peak; Rist Cañon; Horsetooth Gulch; Michigan; Leroux Creek; Howe's Gulch; Silverton; Mount Garfield.

2. *Filix montana* (Lam.) Underw. On rocks, Lab. and Que. to B. C. and Colo.—Alt. about 10,500 ft.—Mt. Antero, Saguache Range.

7. *PTERIDIUM* Scopoli. BRACKEN.

1. *Pteridium aquilinum pubescens* Underw. [*Pteris aquilina* of western botanists.] On poor soil in open places, Mont. to Calif., Colo. and Ariz.—Alt. 8500–10,000 ft.—Red Mountain road, south of Ouray; near Pagosa Peak; Bosworth's ranch; Rabbit-Ear Range.

8. *CRYPTOGRAMMA* R. Br. PARSLEY-FERN.

Leaves 3–4-pinnatifid, densely cespitose; texture firm.
Leaves 2–3-pinnatifid, scattered; texture flaccid.

1. *C. acrostichoides*.
2. *C. Stelleri*.

1. *Cryptogramma acrostichoides* R. Br. On loose rocks, Lake Superior to Alaska, Colo. and Calif.—Alt. 8500–11,500 ft.—Near Pagosa Peak; Mt. Hesperus; Estes Park, Larimer Co.; West Spanish Peak; Twin Lakes; Red Mountain road, south of Ouray; Clear Creek; Fish Creek Falls, Routt Co.

2. *Cryptogramma Stelleri* (S. C. Gmel.) Prantl. [*Pellaea gracilis* Hook.] On moist rocks, Labr. and Pa. to Colo. and Alaska.—Alt. 7500–9500 ft.—Cañons west of Ouray.

9. *CHEILANTHES* Sw. LIP-FERN.

Leaves hairy or tomentose, not scaly.

Stalks covered with woolly hairs when young, at length nearly smooth.

Stalks and rachises with narrow lanceolate scales.

Leaves covered beneath with imbricated scales, not tomentose.

1. *C. Feei*.
2. *C. Eatonii*.
3. *C. Fendleri*.

1. *Cheilanthes Feei* Moore. [*C. lanuginosa* Nutt.] On dryish rocks, Ill. and Minn. to B. C., Ariz. and Tex.—Alt. 4000-9000 ft.—Trail Glen; Ute Pass; West Indian Creek; North Cheyenne Cañon; Colorado Springs; Cañon City.

2. *Cheilanthes Eatonii* Baker. On rocks, Ariz. to Colo. and Texas.—Alt. about 5800 ft.—Arkansas Cañon.

3. *Cheilanthes Fendleri* Hook. On dry rocks, Texas to Colo. and Calif.—Alt. 5000-8500 ft.—Horsetooth Mountain; Cheyenne Cañon; Green Mountain Falls; Glen Eyrie; Boulder; Arkansas Cañon; Manitou.

10. PELLAEA Link. ROCK-BRAKE.

Simply pinnate; texture thin; pinnae obtuse, narrower when fertile.

1. *P. Breweri*.

Bi—tri-pinnate; texture coriaceous.

Pinnae obtuse or barely acute.

2. *P. atropurpurea*.

Pinnae mucronulate.

3. *P. Wrightiana*.

1. *Pellaea Breweri* D. C. Eaton. On rocks, Mont., Ore. and Calif.—Reported from Colorado, but exact locality not given.

2. *Pellaea atropurpurea* (L.) Link. On rocks, New England to B. C., southward to Ga., Texas and Ariz.—Alt. about 7500 ft.—Box Cañon, Ouray.

3. *Pellaea Wrightiana* Hook. On rocks, Kans. to Texas and Calif.—Cañon City.

11. NOTHOLAENA R. Br. CLOAK-FERN.

1. *Notholaena Fendleri* Kunze. On exposed rocks, Wyo. to N. M. and Ariz.—Alt. 6000-9500 ft.—Cheyenne Cañon, base of Pike's Peak; Queen's and William's Cañons; Arkansas Cañon; Colorado Springs; Ute Pass; Clear Creek Cañon, at Dumont; South Cheyenne Cañon; between La Veta and Gardner; La Veta; Bergen Park.

12. ASPLENIUM L. SPLEENWORT.

Leaves simply pinnate.

Rachis chestnut brown or blackish.

Pinnae 2-3 cm. long, auriculate on the upper side at base.

1. *A. platyneuron*.

Pinnae 1 cm. long, obliquely oval, not auriculate at base.

2. *A. Trichomanes*.

Rachis green; pinnae ovate-rhomboidal, oblique at base.

3. *A. viride*.

Leaves bipinnate.

4. *A. Andrewsii*.

1. *Asplenium platyneuron* (L.) Oakes. [*A. ebenum* Aiton] On rocks, Me. to Fla., Tex., N. M. and Colo.—Green Horn Mountains (*Greene*).

2. *Asplenium Trichomanes* L. On limestone rocks, quite generally east of the Rocky Mountains.—Alt. 5000-7000 ft.—South Boulder Cañon; Horsetooth Mountain; Horsetooth Gulch.

3. *Asplenium viride* Huds. On rocks, N. Br. and Vt. to Alaska, Ore. and Wyo.—Reported from Colorado, but exact locality not given.

4. *Asplenium Andrewsii* A. Nelson. Sandstone cliff, in Colo.—Boulder Creek.

13. ATHYRIUM Roth. LADY-FERN.

1. *Athyrium Filix-foemina* (L.) Roth. In moist, shady places, Newf. to B. C., Calif. and Fla.—Alt. about 9000 ft.—Near Pagosa Peak; Fish Creek Falls, Routt Co.

14. **BELVISIA** Mirb.

1. **Belvisia septentrionalis** (L.) Mirb. (*Asplenium septentrionale* Hoffm.)
On rocks, S. D. to Mont., N. M. and Ariz.—Alt. 6000-6500 ft.—Horsetooth
Mountain; South Boulder Cañon; Arkansas Cañon.

Order 3. **SALVINIALES.**

Family 3. **MARSILEACEAE** R. Br. **MARSILIA** FAMILY.

1. **MARSILEA** L.

1. **Marsilea vestita** Hook. & Grev. Wet, sandy soil, Ark. and Tex. to
Calif., B. C. and S. D.—Saguache (*Wolf*).

Order 4. **EQUISETALES.**

Family 4. **EQUISETACEAE** Michx. **HORSETAIL** FAMILY.

1. **EQUISETUM** L. **HORSETAIL.**

Stems annual, copiously branching.

Spike-bearing stems pale, soon withering; sheaths of branches 4-toothed.

1. *E. arvense.*

Spike-bearing stems withering at apex, producing branches below; sheaths of
branches 3-toothed.

2. *E. pratense.*

Stems perennial, evergreen; branches few.

Stems smoothish, 14-30-furrowed.

3. *E. laevigatum.*

Stems roughened, 5-10-furrowed.

4. *E. variegatum.*

1. **Equisetum arvense** L. In sandy places, Greenl. and Va. to Calif. and
Alaska.—Alt. 5000-10,000 ft.—Fort Collins; Ouray; West Indian Creek;
Mancos; Bob Creek, west of Mt. Hesperus; Hotchkiss.

2. **Equisetum pratense** Ehrh. Along streams, N. Sc. to N. J., Colo. and
Neb.—Alt. up to 10,500 ft.—Bob Creek, west of Mt. Hesperus.

3. **Equisetum laevigatum** A. Br. Moist places, N. J. to Tex., B. C. and
Calif.—Alt. 4000-12,500 ft.—Gunnison; Parlin; Ft. Collins; West Spanish
Peak; Cucharas River, below La Veta; Wahatoya Creek; Trimble Springs;
Mancos; Grand Junction.

4. **Equisetum variegatum** Schleich. In sandy soil, Arctic America to N.
Y. and Nev.—Clear Creek, near Denver (*Coulter*).

Order 5. **ISOETALES.**

Family 5. **ISOETACEAE** Horan. **QUILLWORT** FAMILY.

1. **ISOETES** L. **QUILLWORT.**

Stomata wanting; leaves 40-60, rigid; microspores whitish, papillose.

1. *I. paupercula.*

Stomata present; leaves 5-25, soft; microspores deep brown, spinulose.

2. *I. Bolanderi.*

1. **Isoetes paupercula** (Engelm.) A. A. Eaton. [*I. occidentalis* Henderson,
I. lacustris paupercula Engelm.] In lakes, always submerged; Colo. to Calif.,
Wash. and Ida.—Grand Lake, Middle Park.

2. *Isoetes Bolanderi* Engelm. In ponds, Mont. to Wash., Colo. and Calif.
—"Western Colorado."

Order 6. LYCOPODIALES.

Spores uniform, minute.

Family 6. LYCOPODIACEAE.

Spores of two sorts, minute microspores and larger macrospores.

Family 7. SELAGINELLACEAE.

Family 6. LYCOPODIACEAE Michx. CLUBMOSS FAMILY.

1. LYCOPODIUM L. CLUB-MOSS, RUNNING PINE.

1. *Lycopodium annotinum* L. In open places in forest, Mass. and Newf. to Colo., Wash. and Alaska.—Alt. 9000-10,500 ft.—Beaver Creek; Estes Park; Front Range, Larimer Co.; Notch Mountain.

Family 7. SELAGINELLACEAE Underw. SELAGINELLA FAMILY.

1. SELAGINELLA Beauv. LITTLE CLUB-MOSS.

Stems rooting at base only; spikes thick, with lax bracts; macrospores spinulose.

1. *S. selaginoides*.

Stems rooting their entire length; bracts rigid.

Leaves without bristles at the ends; stems slender, wiry.

2. *S. mutica*.

Leaves with distinct terminal bristles.

Stems short, compact; leaves light green, crowded, with long terminal bristles.

3. *S. densa*.

Stems long, loosely spreading; leaves dark green, lax, with short terminal bristles.

4. *S. Underwoodii*.

1. *Selaginella selaginoides* (L.) Link. In open places in high mountains, Labr. and northern N. Y. to Alaska and Colo. Exact locality not given.

2. *Selaginella mutica* D. C. Eaton. On rocks, N. M. to Colo. and Calif.—Alt. 6000-6500 ft.—Idaho Springs; South Cheyenne Cañon; North Cheyenne Cañon; Royal Gorge.

3. *Selaginella densa* Rydb. (*S. Engelmanni* Hieron.) On exposed rocks, S. D. and western Neb. to Mont. and Colo.—Alt. about 7000 ft.—The Rustic, Larimer Co.

4. *Selaginella Underwoodii* Hieron. (*S. rupestris Fendleri* Underw.) On exposed rocks, N. Mex. and Colo.—Alt. 5000-7500 ft.—North Cheyenne Cañon; Minnehaha; Pike's Peak; South Cheyenne Cañon; Boulder; foothills near Ft. Collins; Manitou.

Subkingdom SPERMATOPHYTA SEED-BEARING PLANTS.

Class 1. GYMNOSPERMAE.

Order 7. PINALES.

Carpellary scales with bracts, never peltate; ovules inverted; buds scaly; wing accompanying the seed a portion of the carpellary scale; cones dry.

Fam. 8. PINACEAE.

Carpellary scales without bracts, in ours fleshy and peltate; ovules erect; buds naked; wings of the seed (if present) a portion of the testa; cones in ours berrylike.

Fam. 9. JUNIFERACEAE.

Family 8. PINACEAE Lindl. PINE FAMILY.

Leaves usually several together, surrounded by a sheath at the base: cones maturing the second year.

Cone-scales with dorsal, (in ours) spine-armed appendages.

Seeds with elongated wings, these free from the scales and attached to the seeds when these fall.

1. PINUS.

Seeds with rudimentary wings, these adnate to the scales when the seeds fall.

2. CARYOPITYS.

Cone-scales with inconspicuous terminal, unarmed appendages; wing of the seed rudimentary.

3. APINUS.

Leaves solitary, without sheath; cones maturing the first year.

Branchlets rough from the prominent, persistent leaf-bases (sterigmata); leaves in ours quadrangular in cross-section; cones pendulous with persistent scales.

4. PICEA.

Branchlets smooth, the leaf-scars scarcely raised; leaves flat.

Cones pendulous; their scales persistent on the axis; leaves petioled, with transversely oval scars.

5. PSEUDOTSUGA.

Cones erect; their scales deciduous from the axis; leaves sessile with circular scars.

6. ABIES.

1. PINUS L. PINES.

Leaves in fascicles of 4 or 5; spines of the cone-scales long and slender.

1. *P. aristata*.

Leaves in fascicles of 2 or 3; spines of the cone-scales short and stout.

Cones 6-9 cm. long and 5-6 cm. in diameter; leaves 8-15 cm. long.

2. *P. scopulorum*.

Cones 3-5 cm. long and 3 cm. in diameter; leaves 3-6 cm. long.

3. *P. Murrayana*.

1. *Pinus aristata* Engelm. FOXTAIL PINE, HICKORY PINE. Rocky and gravelly mountains from Colo. to Nev., southern Calif. and Ariz.—Alt. 8500-12,500 ft.—Mt. Garfield; Seven Lakes; Como; Veta Pass; Pike's Peak; Middle Park; Gray's Peak.

2. *Pinus scopulorum* (Engelm.) Lemmon. BULL PINE, ROCKY MOUNTAIN YELLOW PINE. Hills and mountains from Nebr. to Mont., Ariz. and N. M.—

Alt. 5000-10,000 ft.—Mountains, Veta Pass; Mancos; Ouray; Minnehaha; Georgetown; Horsetooth Mountain.

3. *Pinus Murrayana* Oreg. Com. LODGE POLE PINE, BLACK PINE. Hills and mountains from Mont. to Alaska, Colo. and Calif.—Alt. 5000-10,000 ft.—Mountains near Veta Pass; Pallas and Sydney; Dillon; Mount Ouray; Breckenridge; Cipango; Baxter's ranch; North Park; Como.

2. CARYOPITYS Small. PIÑONS, NUT PINES.

Cones about 3 cm.; leaves usually in pairs, seldom in threes. 1. *C. edulis*.

Cones 4-5 cm.; leaves singly or rarely in pairs. 2. *C. monophylla*.

1. *Caryopitys edulis* (Engelm.) Small. (*Pinus edulis* Engelm.) Dry foothills and table-lands from southern Wyo. to western Texas, northern Mex., Ariz. and Utah.—Alt. 4000-9000 ft.—Glen Eyrie; Cedar Creek; Red Rock Cañon; Mancos; Salida; Florence; Manitou; Buena Vista; Grand Junction.

2. *Caryopitys monophylla* (Torr. and Frem.) Rydb. (*Pinus monophylla* Torr. and Frem.) Dry hills and mountain slopes from Utah to Calif., Lower California and Ariz. One specimen from Colorado seems to belong here.—Manitou.

3. APINUS Necker. CEMBRA PINES.

1. *Apinus flexilis* (James) Rydb. (*Pinus flexilis* James) ROCKY MOUNTAIN WHITE PINE. Mountains from Alb. to western Texas and southern Calif.—Alt. 7500-11,000 ft.—Clear Creek, Middle Park; Ojo; Graham's Park; North Park; Minnehaha; Beaver Creek; Chambers Lake; Manitou.

4. PICEA Link. SPRUCES.

Branchlets pubescent; cones 3-5 cm. long.

1. *P. Engelmannii*.

Branchlets glabrous; cones 5-9 cm. long.

2. *P. Parryana*.

1. *Picea Engelmanni* (Parry) Engelm. ENGELMANN SPRUCE, WHITE SPRUCE. Mountains, especially on the north sides, from Alb. to B. C., Ore., Ariz. and N. M.—Alt. 8500-12,500 ft.—Empire; Buffalo Pass, Park Range; Mount Baldy; Wahatoya Cañon; Bob Creek, La Plata Mountains; Grand Lake; Cameron Pass.

2. *Picea Parryana* (Andree) Sarg. (*Picea pungens* Engelm.) BLUE SPRUCE, COLORADO SPRUCE. Mountains especially along streams from Wyo. to Utah and N. M.—Alt. 6500-10,000 ft.—Empire; near Pagosa Peak; Crystal Park; Wahatoya Cañon; Cameron Pass.

5. PSEUDOTSUGA Carr. DOUGLAS SPRUCE, RED FIR.

1. *Pseudotsuga mucronata* (Raf.) Sudw. DOUGLAS SPRUCE, RED FIR. Hills and mountains from Alb. to B. C., Calif., northern Mexico and western Texas.—Alt. 6000-11,500 ft.—Pagosa Peak; South Cheyenne Cañon; Colorado Springs; Como; State Bridge, Grand River; Boulder; Manitou; Minnehaha; Mancos; Placer; hills about Ouray; Cameron Pass; Pingree Hill; Stove Prairie.

6. **ABIES** Miller. BALSAMS, FIRS.

Resin ducts of the leaves within the soft tissue, remote from the epidermis.

1. *A. lasiocarpa*.

Resin ducts of the leaves close to the epidermis on the lower side.

2. *A. concolor*.

1. ***Abies lasiocarpa*** (Hook.) Nutt. BALSAM FIR. Subalpine mountains from Alb. to Alaska, Ariz. and N. M.—Alt. 9500–12,500 ft.—West Spanish Peak; Grand Lakes; Empire; Andrew's ranch; Mt. Richtofen; Cameron Pass.

2. ***Abies concolor*** Lindl. WHITE FIR. Along streams in the mountains from Colo. to Ore., Calif. and N. M.—Alt. 8000–10,000 ft.—Wahatoya Cañon; Manitou; Veta Mountain; Bob Creek, west of La Plata; Ouray.

Family 9. **JUNIPERACEAE** Horan. JUNIPER FAMILY.

Leaves subulate on the mature branches; aments axillary, the pistillate with smaller scales at the top.

1. **JUNIPERUS**.

Leaves scalelike and appressed on the mature branches; aments terminal, the pistillate with larger scales at the top.

2. **SABINA**.

1. **JUNIPERUS** L. JUNIPERS.

Low shrub with depressed branches; leaves abruptly bent at the base, deeply channelled, abruptly acute.

1. *J. sibirica*.

Tree or erect shrub; leaves straight or nearly so, shallowly channelled, gradually acuminate.

2. *J. communis*.

1. ***Juniperus sibirica*** Burgsd. MOUNTAIN OR LOW JUNIPER. Exposed rocky mountains and hills from Labr. to Alaska, Utah and N. Y.—Alt. 6500–10,000 ft.—Pike's Peak; Colorado Springs; Empire; Marshall Pass; Golden; Little Beaver; near Veta Pass; Bob Creek, west of La Plata Mountains; Ouray; Grand Lake; between Sunshine and Ward; Ojo; Beaver Creek; Baxter's ranch; Trapper's Lake; Rist Cañon.

2. ***Juniperus communis*** L. JUNIPER. Rocky hills and stony places from Lab. to Mont., N. M. and Ga.—Alt. 5000–8500 ft.—Minnehaha; Colorado Springs.

2. **SABINA** Haller. RED CEDARS, SAVINS, JUNIPERS.

Fruit reddish-brown or bluish by a bloom, with dry-fibrous sweet flesh.

1. *S. utahensis*.

Fruit blue or blue-black, rarely copper-colored, with juicy resinous flesh.

Trees or erect shrubs; fruit on straight peduncle.

Leaves minutely denticulate at the apex; fruit 5–7 mm. in diameter, usually 1-seeded.

2. *S. monosperma*.

Leaves entire; fruit 4–5 mm. in diameter, usually several-seeded.

3. *S. scopulorum*.

Prostrate shrub; fruit on recurved peduncle.

4. *S. prostrata*.

1. ***Sabina utahensis*** (Engelm.) Rydb. (*Juniperus californica utahensis* Engelm.) On dry mountain slopes and table-lands from western Colo. to Nev., southeastern Calif. and Ariz.—Alt. 5000–10,000 ft.—State Bridge; Glenwood Springs; Grand River Valley.

2. *Sabina monosperma* (Engelm.) Rydb. (*Juniperus occidentalis monosperma* Engelm.) Dry foot-hills and mesas from Colo. to Utah, Ariz., N. M. and northern Mexico.—Alt. 5500-7500 ft.—McCoy; Cedar Creek; La Veta; Mancos; Owl Cañon; Rustic.

3. *Sabina scopulorum* (Sarg.) Rydb. (*Juniperus scopulorum* Sarg.) ROCKY MOUNTAIN RED CEDAR. On foot-hills and river bluffs from Alb. to B. C., Ore., Ariz. and Texas.—Alt. 4000-8500 ft.—Colorado Springs; Golden; Garden of the Gods; Ouray; Durango; McCoy; State Bridge, Grand River; Kremmling; Eagle River, Walcott; Boulder; Manitou; New Castle; Salida; Andrew's ranch; Soldier Cañon; Rist Cañon; Trinidad; Owl Cañon.

4. *Sabina prostrata* (Pers.) Antoine. CREEPING JUNIPER, TRAILING SAVIN. Exposed hills and slopes from N. S. to B. C., Colo. and N. Y.—Alt. 4000-8500 ft.—North Cheyenne Cañon; Parlin; Owl Cañon.

Order 8. GNETALES.

Family 10. **EPHEDRACEAE** Dumort. JOINT-FIR FAMILY.

1. **EPHEDRA** Tourn. JOINT-FIRS.

Scales and branches opposite; bracts opposite and connate, scarious only on the margins. 1. *E. antisyphilitica*.

Scales, branches and bracts in threes; the latter scarcely connate; those of the pistillate cones mostly scarious and more or less clawed.

Scales 2-3 mm. long, not becoming shreddy; fruit scarious.

2. *E. Torreyana*.

Scales 6-12 mm. long, becoming shreddy; fruit smooth.

3. *E. trifurca*.

1. *Ephedra antisyphilitica* E. A. Mey. On desert land from Colo. to Texas and Mex.—Mancos.

2. *Ephedra Torreyana* S. Wats. On desert lands to an altitude of 5500 ft. from Colo. and Utah to N. M. and Calif.—Deer Run.

3. *Ephedra trifurca* Torr. On desert lands from southwestern Colo. and Utah to Texas and Ariz.—Mesa Verde; Las Animas Valley (*Brandegee*).

Class 2. **ANGIOSPERMAE.**

Subclass 1. **MONOCOTYLEDONES.**

Order 9. **PANDANALES.**

Flowers in elongated terminal spikes; fruit hidden among bristles.

Fam. 11. **TYPHACEAE.**

Flowers in globose lateral spikes; fruit not hidden among bristles.

Fam. 12. **SPARGANIACEAE.**

Family 11. **TYPHACEAE** J. St. Hil. CAT-TAIL FAMILY.

1. **TYPHA** L. CAT-TAILS.

1. *Typha latifolia* L. In marshes, lakes and streams from Newf. to Wash., Fla. and Calif.; also Mex., Asia and Europe.—Alt. 4000-6000 ft.—Pagosa Springs; Ft. Collins; common in swamps formed by irrigation.

Family 12. **SPARGANIACEAE** Agard. BUR-REED FAMILY.

1. **SPARGANIUM** L. BUR-REED.

Leaves triangular-keeled at the base.

Mature achenes truncate at the apex, stalked; stigmas often 2.

1. *S. eurocarpum.*

Mature achenes acuminate at the apex, sessile; stigma always solitary; lower heads peduncled.

2. *S. multipedunculatum.*

Leaves flat throughout, mostly floating.

Mature heads 12-15 mm. in diameter; style and stigma of about the same length as the achenes.

3. *S. angustifolium.*

Mature heads 7-10 mm. in diameter; style and stigma shorter than the achenes.

4. *S. minimum.*

1. *Sparganium eurocarpum* Engelm. In marshes and slow streams from Newf. to Wash., Fla. and Calif.—Alt. 4000-5500 ft.—Along Platte River, Denver.

2. *Sparganium multipedunculatum* (Morong) Rydb. (*S. simplex multipedunculatum* Morong) In marshes, slow streams and lakes, from the Mackenzie River to Wash. and Colo.—Alt. 6500-10,500 ft.—Gunnison; Cottonwood Lake; Kremmling; West Cliff; margin of lake, Buffalo Pass, Park Range; Estes Park; eight miles west of Hebron.

3. *Sparganium angustifolium* Michx. In lakes and streams from Newf. to Ore., N. Y. and Calif.—Alt. 8500-11,500 ft.—Near Pagosa Peak; Seven Lakes; Trapper's Lake; Estes Park.

4. *Sparganium minimum* Fries. In ponds and streams from N. B. to Alaska, N. Y. and Utah.—Grand Lake; Estes Park.

Order 10. NAIADALES.

Gynoecium of distinct carpels; stigmas disk-like or cup-like.

Fam. 13. ZANICHELLIACEAE.

Gynoecium of united carpels; stigmas 2-4, slender.

Fam. 14. NAIADACEAE.

Family 13. ZANICHELLIACEAE Dumort. POND-WEED FAMILY.

Flowers perfect in peduncled spikes; ovaries sessile; stamens 4; connective appendaged.

1. POTAMOGETON.

Flowers monoecious, axillary; anthers 1; connective not appendaged.

2. ZANICHELLIA.

1. POTAMOGETON L. POND-WEED.

With both floating and submerged leaves.

Submerged leaves bladeless.

1. *P. natans*.

Submerged leaves with proper blade.

Submerged leaf-blades lanceolate.

Submerged leaves all petioled.

2. *P. lonchites*.

Submerged leaves sessile or the uppermost short-petioled.

Peduncles of the same thickness as the stem.

3. *P. alpinus*.

Peduncles thicker than the stem.

4. *P. Zisii*.

Submerged leaves linear.

5. *P. heterophyllus*.

With submerged leaves only.

Leaves with broad blades, lanceolate or oval, many-nerved.

Leaves short-petioled or sessile, not clasping.

6. *P. lucens*.

Leaves clasping.

7. *P. Richardsonii*.

Leaves narrowly linear or capillary.

Stipules free from the leaves.

Glands at the base of the leaves absent.

8. *P. foliosus*.

Glands at the base of the leaves present.

9. *P. pusillus*.

Stipules adnate to the base of the leaves.

Stigma broad, sessile.

Leaves filiform, $\frac{1}{4}$ – $\frac{1}{2}$ mm. wide; stipular sheath 3–8 mm. long.

10. *P. filiformis*.

Leaves about 1 mm. wide; stipular sheath 1–2 cm. long.

11. *P. interior*.

Stigma capitate; style evident.

12. *P. pectinatus*.

1. *Potamogeton natans* L. In lakes and ponds from N. S. to Alaska, Fla. and Calif.; also Mex., Europe and Asia.—Alt. 4000–8000 ft.—Rio Grande, Alamosa; Lee's Lake, Ft. Collins; Laramie River near state line.

2. *Potamogeton lonchites* Tuckerm. In ponds and slow streams from N. B. to Wash., Fla. and Calif.—Alt. 4000–8000 ft.—Alamosa.

3. *Potamogeton alpinus* Balbis. (*P. rufescens* Schrad.) In ponds from N. S. to Alaska, N. J. and Calif.—Alt. 8000–11,500 ft.—Georgetown; Tomichi River; Seven Lakes; Trapper's Lake.

4. *Potamogeton Zizii* M. & K. In lakes and streams from Que. to Ida., Fla. and Texas.—Cerro Summit.
5. *Potamogeton heterophyllus* Schreb. In still or flowing water from Lab. to B. C., Fla. and Calif.—Alt. 5000-6000 ft.—Near Boulder.
6. *Potamogeton lucens* L. In ponds and lakes, from N. Sc. to Fla. and Calif.—Cottonwood Lake.
7. *Potamogeton Richardsonii* (Bennett) Rydb. (*P. perfoliatus lanceolatus* Robbins) In lakes, ponds and slow streams from Newf. to Alaska, Del. and Calif.—Alt. about 8000 ft.—Tomichi River.
8. *Potamogeton foliosus* Raf. In streams and ponds from N. B. to B. C., Fla. and Calif.—Alt. 4000-9000 ft.—North Platte River, below Hebron; Grand River, Sulphur Springs; Platte River, Denver.
9. *Potamogeton pusillus* L. In slow streams and ponds from N. B. to B. C., N. C. and Calif.—Alt. 4000-8000 ft.—Base of Pike's Peak; Brantly Cañon, Las Animas Co.; Alamosa.
10. *Potamogeton filiformis* Pers. In ponds and lakes from Anticosti to B. C., N. Y. and Colo.—Alt. 4000-9000 ft.—Twin Lakes; Walsenburg; Grand Lake.
11. *Potamogeton interior* Rydb. (*P. marinus occidentalis* Robbins) In lakes and slow streams from Alb. to Colo. and Nev.—Alt. 6500-10,000 ft.—San Luis Valley; Iron-ton Park, nine miles south of Ouray; Tomichi River; Gunnison; Hamor's Lake, Durango.
12. *Potamogeton pectinatus* L. In fresh, alkaline or salt water from N. B. to Alaska, Fla. and Low. Calif.—Alt. 4000-10,000 ft.—Twin Lakes; New Windsor; lake near Ft. Collins; Grizzly Creek; Trapper's Lake; Lee's Lake, Ft. Collins.

2. ZANICHELLIA L. ZANICHELLIA.

1. *Zanichellia palustris* L. In fresh and alkaline ponds and streams especially with sandy bottoms from Mass. to Wash., Fla. and Calif.; also in the Old World.—Alt. 4000-9000 ft.—Ft. Collins; Platte River, Denver; stream twelve miles below Grand Lake; swamp along Poudre River.

Family 14. NAIADACEAE Lindl. NAIAS FAMILY.

1. NAIAS L. NAIAS.

1. *Naias guadalupensis* (Spreng.) Morong. In brackish and alkaline water from Kans., Nebr. to Ore., Fla. and Texas; Tropical America.—Lee's Lake, Ft. Collins.

Order 11. ALISMALES.

Petals similar to the sepals; anthers long and narrow; carpels coherent.

Fam. 15. SCHEUCHSERIACEAE.

Petals different from the sepals, in ours white; anthers short and thick; carpels not coherent.

Fam. 16. ALISMACEAE.

Family 15. **SCHEUCHSERIACEAE** Agardh. ARROW-GRASS FAMILY.1. **TRIGLOCHIN** L. ARROW-GRASS.

Carpels 3; fruit linear-clavate, tapering to an awl-shaped base. 1. *T. palustris*.
Carpels 6; fruit oblong or ovoid, obtuse at the base. 2. *T. maritima*.

1. *Triglochin palustris* L. In marshes from N. B. to Alaska, N. Y. and Colo.; also in Europe and Asia.—Alt. 6500-10,000 ft.—Lake John, North Park; Iola; Hamor's Lake, north of Durango; Grizzly Creek; Como; South Park.

2. *Triglochin maritima* L. In marshes, especially those that are more or less alkaline or saline, from Lab. to Alaska, N. J. and Calif.—Alt. 6500-10,000 ft.—Parlin, Gunnison Co.; Doyle's; Trimble Springs, north of Durango; Gypsum, Eagle Co.; Tobe Miller's ranch; Steamboat Springs.

Family 16. **ALISMACEAE** DC. WATER-PLANTAIN FAMILY.

Carpels in a ring on a flat receptacle. 1. **ALISMA**.
Carpels spirally arranged in several series on a convex or globose receptacle. 2. **SAGITTARIA**.

1. **ALISMA** L. WATER-PLANTAIN.

1. *Alisma Plantago* L. (*A. brevipes* Greene) In water from Que. to Wash., Colo. and Low. Calif.; also in Europe.—Alt. 4000-9000 ft.—Cerro Summit; La Porte, Larimer Co.; La Plata River; Piedra; near the river, Ft. Collins; Hubbard Creek, Delta Co.

2. **SAGITTARIA** L. ARROW-HEAD.

Basal lobes of the leaf-blades not longer than the blade proper.

Beak of the achenes at a right angle to the body and of $\frac{1}{4}$ its length or more; bracts ovate. 1. *S. latifolia*.

Beak of the achenes erect, very short.

Bracts lanceolate, 8-20 mm. long; petiole comparatively short; blade seldom floating. 2. *S. arifolia*.

Bracts ovate-lanceolate, 4-6 mm. long; petioles very long; blades floating or none. 3. *S. cuneata*.

Basal lobes of the leaf-blades 2-3 times as long as the blades proper.

4. *S. longiloba*.

1. *Sagittaria latifolia* Willd. In marshes and shallow water from N. B. to B. C., Fla. and Tex.—Lee's Lake, near Ft. Collins; along the river near Ft. Collins.

2. *Sagittaria arifolia* J. G. Smith. In shallow water and mud from Me., Sask., B. C. and Mich. to N. M. and Calif.—Alt. 4000-8500 ft.—Near Boulder; New Windsor, Weld Co.; North Cheyenne Cañon; Alamosa; Kremmling; La Porte road, near Ft. Collins.

3. *Sagittaria cuneata* Sheldon. In lakes from Minn. to Sask., B. C. and Colo.—"Colorado."

4. *Sagittaria longiloba* Engelm. In shallow ponds from Kans. to Colo., Tex. and Sonora.—Exact locality not given.

Order 12. HYDROCHARITALES.

Family 17. ELODIACEAE Dumort. TAPE-GRASS FAMILY.

1. PHILOTRIA Raf. WATER-WEED.

Calyx over 2.5 mm. broad.

Calyx less than 2 mm. broad.

1. *P. angustifolia*.

2. *P. minor*.

1. *Philotria angustifolia* (Muhl.) Britton. In ponds and slow-flowing water from N. Y. to Sask., Ky. and Nev.—Alt. 4000-6500 ft.—Lee's Lake, Ft. Collins.

2. *Philotria minor* (Engelm.) Small. In ponds and slow-flowing streams from Me. to Minn., Wyo., Tenn. and Colo.—Alt. 4000-6000 ft.—Rio Grande; Alamosa; Lee's Lake.

Order 13. POALES.

Leaves 2-ranked; their sheath with their margins not united; stem mostly hollow; fruit a grain. Fam. 18. POACEAE.

Leaves 3-ranked; their sheath with united margins; stem solid; fruit an achene. Fam. 19. CYPERACEAE.

Family 18. POACEAE R. Br. GRASS FAMILY.

Spikelets falling from the pedicels entire, naked or enclosed in bristles or bur-like involucre, 1-flowered, or if 2-flowered the lower flower staminate; no upper empty glumes; rachilla not extending above the upper glume.

Spikelets round or somewhat compressed dorsally; empty glumes manifest; hilum punctiform.

Flowering glume and palea hyaline, thin, much more delicate in texture than the empty glumes.

Spikelets in pairs, one sessile and the other pedicellate.

Tribe 1. ANDROPOGONEAE.

Spikelets not in pairs (*Alopecurus*, *Polypogon*, *Cinna*, etc.).

Tribe 6. AGROSTIDEAE.

Flowering glume, at least that of the perfect flower, similar in texture to the empty glumes, or thicker and firmer, never hyaline and thin.

Flowering glume and palea membranous; the first glume usually larger than the rest. Tribe 2. ZOYSIEAE.

Flowering glume and palea chartaceous to coriaceous, very different in color and appearance from the remaining glumes. Tribe 3. PANICEAE.

Spikelets much compressed laterally; empty glumes none or rudimentary; hilum linear. Tribe 4. ORYZEAE.

Spikelets with the empty glumes persistent, the rachilla articulated above them, 1-many-flowered; frequently the upper glumes are empty; rachilla often produced beyond the upper glume.

Spikelets borne in an open or spike-like panicle or raceme, usually upon distinct pedicels.

Spikelets 1-flowered.

Empty glumes 4; palea 1-nerved.

Tribe 5. PHALARIDEAE.

Empty glumes 2, rarely 1; palea 2-nerved (except in *Cinna*).

Tribe 6. AGROSTIDEAE.

Spikelets 2-many-flowered.

Flowering glumes usually shorter than the empty glumes; the awn dorsal and usually bent. Tribe 7. AVENAE.

Flowering glumes usually longer than the empty ones; the awn terminal and straight (rarely dorsal in *Bromus*) or none.

Tribe 9. FESTUCEAE.

Spikelets in two rows sessile or nearly so.

Spikelets on one side of the continuous axis, forming one-sided spikes.

Tribe 8. CHLORIDEAE.

Spikelets alternately on opposite sides of the axis, which is often articulated.

Tribe 10. HORDEAE.

TRIBE 1. ANDROPOGONEAE.

Racemes singly disposed; apex of the rachis-internodes a translucent cup-shaped appendage.

1. SCHIZACHYRIUM.

Racemes disposed in pairs or more; apex of the rachis-internodes not appendaged.

Rachis-internodes and pedicels sulcate, the median portion translucent, the margins thickened.

2. AMPHILOPHIS.

Rachis-internodes not sulcate.

Some or all of the racemes sessile.

3. ANDROPOGON.

All of the racemes more or less peduncled.

Pedicellate spikelets wanting.

4. SORGHASTRUM.

Pedicellate spikelets present and usually staminate.

5. SORGHUM.

TRIBE 2. ZOYSIEAE.

Only one genus represented.

6. HILARIA.

TRIBE 3. PANICEAE.

Spikelets naked, not involucrate.

Empty glumes 2.

Rachis produced beyond the upper spikelet; spikelets narrow.

37. SPARTINA.

Rachis not so produced; spikelets globose.

38. BECKMANNIA.

Empty glumes 3.

Empty glumes not awned.

Spikelets in very slender 1-sided racemes, which are usually whorled or approximate.

7. SYNTERISMA.

Spikelets in panicles or panicle racemes.

Spikeles lanceolate, acuminate, long-hairy.

8. TRICHACHNE.

Spikelets orbicular or lanceolate; if the latter, then glabrous.

9. PANICUM.

Empty glumes awned or awn-pointed.

10. ECHINOCHLOA.

Spikelets involucrate.

Involucre of numerous bristles.

11. CHAETOCCHLOA.

Involucre of two spine-bearing valves.

12. CENCHRUS.

TRIBE 4. ORYZEAE.

Spikelets perfect; empty glumes wanting or rarely rudimentary.

13. HOMALOCENCHRUS.

TRIBE 5. PHALARIDEAE.

Third and fourth glumes empty, awnless.

14. PHALARIS.

Third and fourth glumes enclosing staminate flowers.

15. SAVASTANA.

TRIBE 6. AGROSTIDEAE.

Flowering glumes indurate when mature and very closely embracing the grain, or at least firmer than the empty glumes.

Spikelets all perfect not in pairs.

Flowering glume 3-awned.

16. ARISTIDA.

Flowering glume 1-awned.

Awn twisted and bent.

17. STIPA.

Awn not twisted.

- Flowering glumes broad; awn deciduous.
 Flowering glumes glabrous, or pubescent with short appressed hairs.
 18. *ORYZOPSIS*.
 Flowering glumes pubescent with long, silky hairs much exceeding the glume.
 19. *ERIOCOMA*.
 Flowering glumes narrow; glabrous or with short, appressed hairs; the awn persistent.
 20. *MUHLENBERGIA*.
 Spikelets in pairs, one perfect and the other staminate or sterile, in a spike-like panicle.
 21. *LYCURUS*.
 Flowering glumes usually hyaline or membranaceous at maturity; at least more delicate than the empty ones; grains loosely enclosed.
 Stigma sub-plumose (*i. e.*, with short hairs all around), projecting from the apex of the nearly closed glumes.
 Inflorescence spike-like.
 Rachilla of the spikelets articulated above the empty glumes, which are therefore persistent.
 22. *PHLEUM*.
 Rachilla of the spikelets articulated below the empty glumes, hence the spikelets deciduous entire.
 23. *ALOPECURUS*.
 Inflorescence an open small panicle; dwarf arctic-alpine plant.
 24. *PHIPPSIA*.
 Stigma plumose, projecting from the sides of the spikelets; inflorescence an open or spike-like panicle.
 Grain not permanently enclosed in the flowering scale and palet; pericarp opening readily at maturity.
 Flowering glumes long-hairy on the veins.
 25. *BLEPHARINEURON*.
 Flowering glumes not long-hairy on the veins.
 26. *SPOROBULUS*.
 Grain permanently enclosed in the flowering glume and the palet; pericarp adherent.
 Spikelets readily falling off entire when mature.
 27. *POLYPOGON*.
 Spikelets with the empty scales at least persistent.
 Palet 1-nerved and 1-keeled; stamen 1.
 28. *CINNA*.
 Palet 2-nerved and 2-keeled or sometimes wanting; stamen 3.
 Flowering glumes naked at the base.
 29. *AGROSTIS*.
 Flowering glumes with long hairs at the base.
 Flowering glume and palet thin-membranous.
 30. *CALAMAGROSTIS*.
 Flowering glume and palet chartaceous.
 31. *CALAMOVILFA*.

TRIBE 7. AVENEAE.

- Awn of the flowering glumes inserted dorsally below the teeth.
 Grain free, unfurrowed; spikelets less than 1 cm. long.
 Flowering glumes crose-toothed or shortly 2-lobed at the apex.
 32. *DESCHAMPSIA*.
 Flowering glumes 2-cleft or deeply 2-toothed at the apex; teeth awn-pointed.
 Awn twisted and bent.
 33. *TRisetum*.
 Awn if present not twisted, straight.
 34. *GRAPHEPHORUM*.
 Grain furrowed, adherent to the glumes; spikelets exceeding 1 cm. in length.
 Ovary not crowned by a villous appendage.
 35. *AVENA*.
 Ovary crowned by a villous appendage (awned species of)
 65. *BROMUS*.
 Awn of the flowering glumes inserted between the teeth.
 36. *DANTHONIA*.

TRIBE 8. CHLORIDEAE.

- Spikelets with perfect flowers.
 Spikelets with 1 (rarely 2) perfect flowers.
 Spikelets deciduous as a whole; rachis articulated below the empty glumes.
 Rhachis produced above the upper spikelet; spikelets narrow.
 37. *SPARTINA*.
 Rhachis not produced beyond the upper spikelet; spikelets globose.
 38. *BECKMANNIA*.

Spikelets with at least the empty glumes persistent.

Glumes above the perfect flower none; spikes digitate, very slender.

39. *SCHEDONARDUS*.

Glumes above the perfect flower 1-several; spikes scattered.

Spikes 1-4, rarely more; spikelets 25 or more.

40. *BOUTELOUA*.

Spikes numerous, 12 or more; spikelets few, less than 12.

41. *ATHEROPOGON*.

Spikelets with 2-3 perfect flowers; spikelets alternate.

42. *LEPTOCHLOA*.

Spikelets dioecious; those of the two sexes very unlike.

43. *BULBILIS*.

TRIBE 9. FESTUCEAE.

Flowering glumes, at least of the pistillate spikelets, 3-lobed and 3-awned; plant dioecious.

44. *SCLEROPOGON*.

Flowering glumes entire or at most 2-lobed.

Hairs on the rachilla or flowering glume very long and enclosing the latter.

45. *PHRAGMITES*.

Hairs, if any, on the rachilla and the flowering glume shorter than the glume.

Stigmas barbellate on elongated styles; spikelets in threes in the axils of spinescent leaves.

46. *MUNROA*.

Stigmas plumose, sessile or on short styles.

Flowering glumes 1-3-nerved.

Lateral nerves of the flowering glumes hairy.

Flowering glumes deeply 2-lobed.

Internodes of the rachilla long, often half as long as the flowering glume; plants without stolons.

47. *TRIPLASIS*.

Internodes of the rachilla short, many times shorter than the glumes; plants with long, arching stolons.

48. *DASYOCHLOA*.

Flowering glume entire or slightly 2-lobed; internodes of the rachilla short.

Inflorescence a short congested raceme; leaf-blades with thick cartilaginous margins.

49. *ERIONEURON*.

Inflorescence a panicle; leaf-blades not with cartilaginous margins.

Panicle simple or compound; the spikelets on pedicels of varying length.

50. *TRIDENS*.

Panicles composed of long branches, along which the appressed spikelets are arranged on short pedicels.

51. *DIPLOCHLE*.

Lateral nerves of the flowering glumes glabrous.

Callus of the flowering glumes copiously pubescent with long hairs; panicle open.

52. *REDFIELDIA*.

Callus of the flowering glumes glabrous.

Second empty glume similar to the first or nearly so.

Panicle narrow, dense and spike-like, shining; its branches erect.

53. *KOELERIA*.

Panicle open; its branches spreading.

Rachilla continuous (except in *E. major*); flowering glume deciduous; palet persistent; plants of dry soil.

54. *ERAGROSTIS*.

Rachilla articulated; flowering glumes and palet both deciduous with the rachilla-internodes; water plants with 2-flowered spikelets.

55. *CATABROSA*.

Second empty glume very unlike the first one, broad at the summit.

56. *EATONIA*.

Flowering glumes 5-many-nerved.

Spikelets with two or more of the upper glumes empty, broad and enfolding each other.

57. *MELICA*.

Spikelets with upper glumes flower-bearing or narrow and abortive.

Stigmas placed at or near the apex of the ovary.

Spikelets borne in one-sided fascicles which are arranged in a glomerate or interrupted panicle; flowering glumes herbaceous.

58. *DACTYLIS*.

Spikelets borne in panicles of racemes.

Glumes more or less compressed and keeled.

Spikelets cordate, large.

59. BRIZA.

Spikelets not cordate.

Plants dioecious; flowering glume of the pistillate spikelets coriaceous; palet strongly 2-keeled and serrate on the margin.

60. DISTICHLIS.

Plants with perfect flowers or in some species of *Poa* dioecious; spikelets all alike; flowering glume thin; palet ciliate or smooth on the margin

Flowering glumes scarious-margined; rachis glabrous or with webby hairs.

61. POA.

Flowering glumes membranous, not scarious-margined; rachis with stiff hairs, extending into a hairy appendage.

34. GRAPHEPHORUM.

Glumes rounded on the back, at least below.

Flowering glumes obtuse or acutish and scarious at the apex, usually toothed.

Flowering glumes distinctly 5-7-nerved; style present.

62. PANICULARIA.

Flowering glumes obscurely 5-nerved; style none.

63. PUCCINELLIA.

Flowering glumes acute, pointed or more commonly awned at the apex.

64. FESTUCA.

Stigmas plainly arising below the apex of the ovary which is tipped by a hairy cushion.

65. BROMUS.

TRIBE 10. HORDEAE.

Spikelets usually single at the nodes of the rachis.

Empty scales broad, with their sides turned towards the rachis.

66. AGROPYRON.

Empty glumes with their back turned to the rachis.

70. LOLIUM.

Spikelets 2-6 at each joint of the rachis, or if solitary the empty glumes arranged obliquely to the rachis.

Spikelets 1-flowered or with a rudimentary second flower.

67. HORDEUM.

Spikelets 2-many-flowered.

Rachis of the spikes articulated, readily breaking up into joints.

68. SITANION.

Rachis of the spikes continuous, not breaking up into joints.

69. ELYMUS.

Tribe 1. ANDROPOGONEAE.

1. SCHIZACHYRIUM Nees. BUNCH-GRASS, BROOM-GRASS.

1. *Schizachyrium scoparium* (Michx.) Nash. (*Andropogon scoparium* Michx.) On sandy or dry gravelly hills from N. B. to Sask., Fla. and Tex.—Alt. 4000-7500 ft.—Near Boulder; Cheyenne Mountain; Engelmann Cañon; New Windsor, Weld Co.; Royal Gorge; La Porte, Tobe Miller's ranch; Poudre Cañon; Ft. Collins.

2. AMPHILOPHIS Nash.

1. *Amphilophis Torreyanus* (Steud.) Nash. (*Andropogon saccharoides* of Coult. Man.; not Sw.) In dry soil from Mo. to Colo., Tex. and Ariz.; also in Mex.—Alt. 4000-5500 ft.—Cañon City.

3. **ANDROPOGON** L. BEARD-GRASS, BLUE-STEM.

Fourth glume of the sessile spikelet with a long geniculate awn, more or less spiral at the base.

Outer two glumes of the sessile spikelet more or less hispidulous all over; hairs on the rachis-internodes usually 2 mm. or less long. 1. *A. furcatus*.

Outer two glumes of the sessile spikelet smooth or nearly so, except on the nerves; hairs of the rachis-internodes 3-4 mm. long. 2. *A. chrysocomus*.

Fourth glume of the sessile spikelet awnless or with a short, straight, untwisted awn. 3. *A. Hallii*.

1. *Andropogon furcatus* Muhl. In meadows from Me. to Sask., Fla. and Tex.—Alt. 4000-8000 ft.—Near Boulder; La Veta; Golden; West Dry Creek, Larimer Co.; Manitou; Colorado Springs; Tobe Miller's ranch, near La Porte; Ft. Collins.

2. *Andropogon chrysocomus* Nash. In dry meadows from Neb. to Colo., Kans. and Tex.—Alt. 4000-8000 ft.—La Veta; on the plains.

3. *Andropogon Hallii* Hack. In sandy soil from Neb. to Mont., Kans. and Mex.—Exact locality not given.

4. **SORGHASTRUM** Nash. INDIAN GRASS.

1. *Sorghastrum nutans* (L.) Nash. (*Chrysopogon nutans* Benth.) In dry soil from Ont. to Man., Fla. and Ariz.—Alt. 4000-6000 ft.—Near Boulder; New Windsor, Weld Co.; Cañon City; Tobe Miller's ranch, near La Porte; Ft. Collins.

5. **SORGHUM** Pers. JOHNSON GRASS, SUGAR CORN.

1. *Sorghum halapense* (L.) Pers. Cultivated for fodder and occasionally escaped.—Rocky Ford.

Tribe 2. **ZOYSIEAE.**6. **HILARIA** H. B. K. MESQUITE, BLACK GRAMA.

Outer glumes of the spikelets cuneate, awnless; the nerves strongly diverging.

Outer glumes linear or oblong, awned; the nerves parallel. 1. *H. mutica*.
2. *H. Jamesii*.

1. *Hilaria mutica* (Buckl.) Benth. On dry plains from southern Colo. to Tex. and Ariz.—Reported from Colorado, but doubtful.

2. *Hilaria Jamesii* (Torr.) Benth. Hillsides and gulches of the mesas from Wyo. to Nev., Tex. and N. Mex.—Alt. 4000-6000 ft.—Deer Run; mesas near Pueblo; Arboles; Mancos; Hotchkiss, Delta Co.

Tribe 3. **PANICEAE.**7. **SYNTHERISMA** Walt. CRAB-GRASS.

Pedicels terete or nearly so, sparingly if at all hispidulous; lower sheath glabrous.

Pedicels sharply 3-angled; the angles strongly hispidulous; as are also the sheaths. 1. *S. humifusum*.
2. *S. sanguinale*.

1. *Syntherisma humifusum* (Pers.) Rydb. On roadsides, in old fields and waste places, introduced from the Old World and established from N. S. to Mont. and Colo. and Fla.—Alt. 4000-9000 ft.—Georgetown; Ft. Collins.

2. *Syntherisma sanguinale* (L.) Dulac. (*Panicum sanguinale* L.) In lawns, cultivated ground and waste places; introduced from the Old World and established from Mass. to Neb., Fla. and Calif.—Alt. about 5000 ft.—Boulder; Cañon City; Ft. Collins.

8. TRICHACHNE Nees.

1. *Trichachne saccharatum* (Buckley) Nash. On dry hillsides from Colo. to western Tex., Ariz. and Mex.—Alt. up to 8500 ft.—Cañon City; Fremont Co.

9. PANICUM L. PANIC-GRASS, WITCH-GRASS, SWITCH-GRASS, MILLET.

Basal leaf-blades long and narrow; spikelets lanceolate to ovate, acute to acuminate.

Annual.

Perennial with long, scaly root-stock.

Basal leaf-blades ovate to lanceolate; spikelets elliptic to ovate or obovate, obtuse.

Spikelets less than 2 mm. long.

Spikelets more than 2 mm. long.

1. *P. capillare*.

2. *P. virgatum*.

3. *P. unciphyllum*.

4. *P. Scribnerianum*.

1. *Panicum capillare* L. In sandy soil and waste places from S. Dak. to B. C., N. M. and Calif.—Alt. 4000-9500 ft.—Black Cañon; Ft. Collins; Pike's Peak; Grand Junction; near Boulder; Cañon City; Colorado Springs; Graymont.

2. *Panicum virgatum* L. In meadows and on river-banks from Me. to Ass., Fla. and Ariz.—Alt. 4000-7500 ft.—Ft. Collins; Golden; Trimble Springs; New Windsor, Weld Co.; near Boulder; La Veta; Tobe Miller's ranch.

3. *Panicum unciphyllum* Trin. (*P. pubescens* and *P. dichotomum* of Coult. Man.) In dry or sandy soil from Me. to B. C., Ga. and Ariz.—Exact locality not given.

4. *Panicum Scribnerianum* Nash. (*P. scoparium* of Coult. Man.; not Lam.) In meadows from Me. to B. C., Va., Ariz. and Ore.—Alt. 4000-6000 ft.—Foot-hills, Larimer Co.; Palmer Lake; Brantly Cañon, Las Animas Co.; Boulder.

10. ECHINOCHLOA Beauv. BARNYARD-GRASS, COCKSPUR-GRASS.

1. *Echinochloa Crus-galli* (L.) Beauv. (*Panicum Crus-galli* L.) In sandy or alkaline soil, waste places and old fields.—Alt. 4000-5500 ft.—Golden; Grand Junction; Dry Creek, Larimer Co.; Cañon City.

Echinochloa Crus-galli mutica is a variety with short awn.—Golden; Tobe Miller's ranch, near La Porte; Ft. Collins.

11. CHAETOCHLOA Scribn. FOX-TAIL GRASS, ITALIAN MILLET, HUNGARIAN GRASS.

Inflorescence with the spikelets racemosely arranged; bristles 5-16 at the base of each spikelet, involucrate, tawny-orange.

1. *C. glauca*.

Inflorescence with the spikelets in clusters or on branches; bristles 1-3 at the base of each spikelet, not involucrate.

Second glume of the spikelet as long as the flowering glume or very nearly so; annuals.

Panicle usually 1 cm. thick or less; bristles commonly green; spikelets about 2 mm. long. 2. *C. viridis*.

Panicle usually 1-3 cm. thick; bristles usually purple; spikelets 2.5-3 mm. long. 3. *C. italica*.

Second glume manifestly shorter than the flowering glume; perennial.

4. *C. composita*.

1. *Chaetochloa glauca* (L.) Scribn. (*Setaria glauca* Beauv.) YELLOW FOX-TAIL. In waste places and cultivated grounds from Vt. to Man., Fla. and Tex.—Alt. up to 5000 ft.—Ft. Collins.

2. *Chaetochloa viridis* (L.) Scribn. (*Setaria viridis* Beauv.) GREEN FOX-TAIL. In cultivated ground and waste places from Me. to Wash., Fla. and Calif.—Alt. 4000-6000 ft.—Near Boulder; Idaho Springs; Ft. Collins; Granada.

3. *Chaetochloa italica* (L.) Scribn. (*Setaria italica* Kunth.) ITALIAN MILLET, HUNGARIAN GRASS. Cultivated and escaped in fields and waste places from Que. to Minn., Fla. and Colo.—Grass station, Ft. Collins.

4. *Chaetochloa composita* (H. B. K.) Scribn. In dry soil from Tex. to Colo. and Ariz.; also in Mex.—Alt. 4000-6000 ft.—Cañon City.

12. *CENCHRUS* L. SAND-BUR, SAND-SPUR, COCK-SPUR, BUR-GRASS.

1. *Cenchrus tribuloides* L. In sandy soil from Me. to Minn., Fla. and Tex.—Alt. 4000-6500 ft.—Near Boulder; Ft. Collins; Cañon City; Colorado Springs.

Tribe 4. ORYZEAE.

13. *HOMALOCENCHRUS* Mieg. RICE CUT-GRASS, CATCH-FLY GRASS.

1. *Homalocenchrus oryzoides* (L.) Poll. In wet places and swamps from N. Sc. to Wash., Fla. and Calif.—Alt. 4000-5500 ft.—New Windsor, Weld Co.; Cañon City; river-flats east of Ft. Collins.

Tribe 5. PHALARIEAE.

14. *PHALARIS* L. CANARY-GRASS.

Outer glumes not winged; inflorescence a narrow panicle. 1. *P. arundinacea*.

Outer glumes winged; inflorescence a spike or spike-like panicle.

Spikelets narrow; third and fourth glumes much reduced; blade subulate, hairy.

2. *P. caroliniana*.

Spikelets broad, third and fourth glumes thin, membranous; blade lanceolate,

glabrous or sparingly hairy.

3. *P. canariensis*.

1. *Phalaris arundinacea* L. In swamp and wet meadows from N. Sc. to B. C., N. J. and Nev. Also in Europe and Asia.—Alt. 4000-9000 ft.—Georgetown; Gunnison; New Windsor, Weld Co.; Fort Collins; Hamor's Lake; Table Rock.

2. *Phalaris caroliniana* Walt. In wet soil from S. C. to Calif., Fla. and Mex.—Brantly Cañon, Las Animas Co.

3. *Phalaris canariensis* L. Introduced from Europe and Africa; in waste places from N. S. to S. D., Va. and Colo.—Alt. up to 8500 ft.—Gunnison; Colorado Springs.

15. **SAVASTANA.** HOLY GRASS, VANILLA GRASS.

1. *Savastana odorata* (L.) Scribn. (*Hierochloa borealis* R. & S.) Among bushes and on banks from Lab. to Alaska, N. J. and Ariz.—Alt. 6500-8500 ft.—Stove Prairie, Larimer Co.; West Cliff; South Park; along the Conejos River, north of Antonito.

Tribe 6. **AGROSTIDEAE.**

16. **ARISTIDA** L. POVERTY GRASS, WIRE GRASS.

Spikelets crowded, 4-6 on the short panicle-branches, which are spikelet-bearing to the base or nearly so. 1. *A. fasciculata*.

Spikelets not crowded, usually 1-3, or if more the branches of the panicle or their divisions with a long, naked base

Second glume of the spikelet 1.5 cm. long or less, usually equalling or slightly exceeding the flowering glume. 2. *A. Fendleriana*.

Second glume of the spikelet 2 cm. long, from more than $\frac{1}{2}$ longer than to nearly twice as long as the flowering glume. 3. *A. longiseta*.

1. *Aristida fasciculata* Torr. In dry soil from Kans. to Calif. and Tex.; also in Mex.—Alt. up to 5500 ft.—Cañon City.

2. *Aristida Fendleriana* Steud. (*A. purpurea* Coult.; not Nutt.) In dry sandy soil from S. D. to Mont., Tex. and Calif.—Alt. 4000-8500 ft.—Los Pinos; Buena Vista; South Park; Salida, Chaffee Co.

3. *Aristida longiseta* Steud. In dry soil from Ill. to S. D., Wash., Tex. and Mex.—Alt. 4000-8500 ft.—Near Boulder; Trail Glen; New Windsor, Weld Co.; mountains between Sunshine and Ward; Arboles; Durango; Ft. Collins; Colorado Springs; Cucharas Valley; Denver; Pueblo; foot-hills, Larimer Co.; Palisades; Cañon City.

17. **STIPA** L. PORCUPINE-GRASS, OAT-GRASS, WILD OATS.

Outer glumes of the spikelet 2 cm. long or more.

Awn plumose.

1. *S. neo-mexicana*.

Awn not plumose.

Base of panicle usually included in upper sheaths; flowering scale 8-12 mm. long; awn slender and curled above. 2. *S. comata*.

Base of panicle exerted; flowering scale over 12 mm. long; awn straight above or nearly so.

Flowering scales 12-15 mm. long.

3. *S. Tweedyi*.

Flowering scales 20-25 mm. long.

4. *S. spartea*.

Outer glumes of the spikelets 1.5 cm. long or less.

Panicle loose and open.

Awn plumose; panicle-branches ascending.

5. *S. Porteri*.

Awn not plumose; panicle-branches diverging or reflexed at maturity.

6. *S. Richardsonii*.

Panicle dense and spike-like.

Empty glumes scarious or hyaline, the nerves hence prominent.

Flowering glumes about 5 mm. long, long-hairy towards the apex.

12. *S. Lettermannii*.

Flowering glumes over 5 mm. long, equally hairy throughout.

Flowering glumes 5-6 mm. long, spindle-shaped when mature; callus short. 7. *S. viridula*.

Flowering glumes 6-7 mm. long, almost cylindric; callus long and pointed. 8. *S. Nelsonii*.

Empty glumes firm, thickish, membranous or herbaceous; nerves not prominent.

Flowering glumes 4-5 mm. long; leaf-blades very narrow, involute. 9. *S. minor*.

Flowering glumes 8-10 mm. long; leaf-blades broad.

Panicle slender; stem low and slender.

10. *S. Scribneri*.

Panicle stout and dense; stem tall and stout.

11. *S. Vaseyi*.

1. *Stipa neo-mexicana* (Thurb.) Scribn. Dry hills from Colo. to N. Mex. and Calif.—Alt. up to 6000 ft.—Colorado Springs.

2. *Stipa comata* Trin. & Rupr. On dry plains and hills, especially in sandy soil, from Alb. to Alaska, N. Mex. and Calif.—Alt. 4000-8500 ft.—Along the Platte River, Denver; New Windsor, Weld Co.; Mancos; Almeha; Ft. Collins; mesas opposite Grand Junction; Rist Cañon; near Narrows along Poudre River.

3. *Stipa Tweedyi* Scribn. Plains and valleys from Alb. to Wash., Colo. and Ariz.—Alt. 5000-10,000 ft.—Ft. Collins; near Badito, between La Veta and Gardner; Walsenburg; Arboles; Grayback mining camps; Black Cañon of the Gunnison; Chester, Saguache Co.; Durango; Mancos; North Park; Gypsum; Rist Cañon.

4. *Stipa spartea* Trin. On prairies from Man. to B. C., Ills. and Colo.—Reported from Colorado Springs (Porter); South Park (Canby, Mehan); but doubtful.

5. *Stipa Porteri* Rydb. (*S. Mongolica* Porter & Coult.; not Turcz.) Mountains of Colo.—Twin Lakes.

6. *Stipa Richardsonii* Link. In meadow lands and hillsides from Alb. to Mont., S. D. and Colo.—Mountains west of Laramie River, Larimer Co.

7. *Stipa viridula* Trin. (*S. parviflora Americana* Schultes) Dry prairies and hills from Sask. to Mont., Kans. and Utah.—Alt. 4000-8500 ft.—Gato; Columbine; plains, Larimer Co.; Rist Cañon.

8. *Stipa Nelsonii* Scribner. Dry plains and hills from Ass. to Ida. and Colo.—Alt. 7500-10,000 ft.—Near Boulder; hills about Box Cañon, west of Ouray; Cerro Summit; Idaho Springs; Poncha Pass; Georgetown; Durango; West Mancos Cañon; Rist Cañon; Poudre Cañon.

9. *Stipa minor* (Vasey) Scribn. (*S. viridula minor* Vasey) Dry hillsides and mountain valleys from Mont. to Utah and N. M.—Alt. 8000-12,500 ft.—North Park; Twin Lakes; Marshall Pass; Roger's; Cumbres; Colorado Springs; Robinson, Summit Co.; Long Gulch; near Chamber's Lake; Ute Pass road; along the Michigan, North Park; Anita Peak, Routt Co.

10. *Stipa Scribneri* Vasey. On foot-hills and mountain-sides of Colo. and N. M.—Alt. 5000-9500 ft.—Plains and foot-hills near Boulder; Trail Glen; Clear Creek Cañon, Golden; near Empire; Royal Gorge; Georgetown.

11. *Stipa Vaseyi* Scribn. (*S. viridula robusta* Vasey.) On foot-hills and mountain-sides from Colo. to Ida., Tex. and N. M.; also in Mex.—Alt. 5000-9000 ft.—Colorado Springs; New Windsor, Weld Co.; Idaho Springs; foot-

hills, Larimer Co.; Pagosa Springs; Manitou; Twin Lakes; Hardin's ranch; Soldier Cañon; gulch west of Soldier Cañon; hills west of Dixon Cañon.

12. *Stipa Lettermannii* Vasey. Hills and plains from Wyo. and Ida. to Colo. and Utah.—Manitou.

18. ORYZOPSIS Michx. MOUNTAIN RICE.

Spikelets, exclusive of awn, 2.5–4 mm. long; leaves very slender and involute.

Outer glumes 3–5 mm. long; inflorescence very narrow with short, erect branches.

1. *O. exigua*.

Outer glumes 2.5 mm. long; inflorescence at length open with long, often spreading or reflexed branches.

2. *O. micrantha*.

Spikelets, exclusive of the awn, 6–8 mm. long; leaves broad and often flat.

3. *O. asperifolia*.

1. *Oryzopsis exigua* Thurber. On hillsides from Mont. to Wash., Colo. and Ore.—Alt. about 8500 ft.—Pearl.

2. *Oryzopsis micrantha* (Trin. & Rup.) Thurber. On hillsides and among bushes, from Ass. to Mont., Neb., N. M. and Ariz.—Alt. 4000–8500 ft.—Estes Park; near Badito, between La Veta and Gardner; Georgetown; Arboles; Idaho Springs; Durango; Glen Eyrie; Walsenburg; Roaring Fork, Larimer Co.

3. *Oryzopsis asperifolia* Michx. In woods from N. Sc. to B. C., Pa. and N. M.—Alt. up to 9000 ft.—Veta Pass.

19. ERIOCOMA Nutt.

Panicle open, dichotomously branched with divergent branches. 1. *O. cuspidata*.
Panicle narrow, with few spikelets on short, erect branches. 2. *O. Webberi*.

1. *Eriocoma cuspidata* Nutt. (*Oryzopsis cuspidata* Benth.) On dry barren plains, cañons and sand-hills from Sask. to Wash., Tex. and Calif.; also Mex.—Alt. 4000–9500 ft.—Grand Junction; Black Cañon; Buena Vista; New Windsor, Weld Co.; Arboles; Pueblo; Fort Collins; Mancos; along Platte River, Denver; Sangre de Cristo Creek; river bluffs north of La Veta; Walsenburg; Howe's Gulch; Cherokee Hill; hills about Trinidad; Dixon Cañon; near Fork's Hotel, Manitou; Middle Park.

2. *Eriocoma Webberi* Thurber. On desert lands from western Colo. to Nev. and Calif.—Alt. up to 5500 ft.—Grand Junction.

20. MUHLENBERGIA Schreb.

Panicle contracted, narrow, spike-like, the short branches rarely spreading.

Empty glumes awl-shaped; leafy and branched plants, with long root-stocks covered by imbricated scales.

Flowering glumes not awned, basal hairs not equalling the flowering glume.

Empty glumes about equalling the flowering glume in length, sharp-pointed, about 3 mm. long.

1. *M. mexicana*.

Empty glumes exceeding the flowering glume, generally twice as long, awned, about 5 mm. long.

2. *M. racemosa*.

Flowering glumes distinctly awned; basal hairs equalling the flowering glume.

3. *M. comata*.

Empty glumes lanceolate to ovate; plants mostly tufted and leafy at the base, only in *M. Richardsonis* with an elongated, scaly root-stock.

Second glume not toothed or slightly so; flowering glume awnless or rarely very short-awned.

Empty glumes more than half as long as the flowering glume, acuminate.

Flowering glumes scabrous, green or dark.

Panicle dense, obtuse, 5-10 mm. wide.

4. *M. Wrightii*.

Panicle slender and lax, attenuate at the apex, less than 5 mm. wide.

5. *M. cuspidata*.

Flowering glumes more or less purplish, sparingly long-hairy.

6. *M. Thurberi*.

Empty glumes less than half as long as the flowering glume, obtuse or abruptly acute.

Spikelets (excluding the awn if present) 1.5 mm. or more long.

Plant with a strong perennial, scaly root-stock.

7. *M. Richardsonis*.

Plant annual; root-stock, if any, very slender.

Flowering glumes merely awn-pointed, decidedly purplish; plant 1-2 dm. high.

Spikelets 2 mm. long or more; inflorescence short and rather dense; stem 0.5-1 mm. thick.

8. *M. simplex*.

Spikelets about 1.5 mm. long; inflorescence slender and lax; stem very slender, filiform.

9. *M. filiformis*.

Flowering glumes with a distinct awn $\frac{1}{2}$ -1 mm. long, greenish; plant 4-6 cm. high.

10. *M. aristata*.

Spikelets about 1 mm. long; plant less than 4 cm. high, annual.

11. *M. Wolfii*.

Second glume sharply 3-5-toothed; flowering glume long-awned; awn at least $\frac{1}{2}$ as long as the glume.

Stem 3-6 dm. high, leafy; panicle 7-12 cm. long; awn 8-15 mm. long.

12. *M. gracilis*.

Stem 1-3 high, almost naked above; panicle 5-7 cm. long; awn 1-4 mm. long.

Spikelets 3-4 mm. long; awn 2-4 mm.; leaves usually stiff.

13. *M. subalpina*.

Spikelets about 2 mm. long; awn 1-2 mm.; leaves filiform.

14. *M. filiculmis*.

Panicle open, its branches long and spreading.

Plants densely caespitose, branched only at the base.

Secondary branches of the panicle single; basal leaves short, strongly recurved.

15. *M. gracillima*.

Secondary branches of the panicle fascicled; basal leaves not recurved.

16. *M. pungens*.

Plants diffusely branched, prostrate.

17. *M. Porteri*.

1. *Muhlenbergia mexicana* (L.) Trin. In wet meadows and swamps from N. B. to N. D., N. C. and Colo.—Alt. 4000-6500 ft.—New Windsor, Weld Co.; Rocky Ford; Fort Collins; gulch west of Soldier Cañon; Tobe Miller's ranch, near La Porte.

2. *Muhlenbergia racemosa* (Michx.) B. S. P. (*M. glomerata* Trin.) In wet meadows from Newf. to B. C., N. J., N. M. and Ore.—Alt. 4000-10,000 ft.—Colorado Springs; Cheyenne Mountain; Engelmann Cañon; vicinity of Ouray; New Windsor, Weld Co.; Estes Park, Larimer Co.; Fort Collins; Black Cañon; Deer Run; Manitou; Middle Park.

3. *Muhlenbergia comata* (Thurb.) Benth. In wet soil, especially in sand from Mont. to Wash., Kans. and Calif.—Alt. 6500-10,000 ft.—Mountains near Pagosa Peak; Gunnison; Carlton Lake, Grand Co.; Georgetown; Gypsum Creek Cañon, Eagle Co.; Twin Lakes; Hinsdale Co.; Empire.

4. *Muhlenbergia Wrightii* Vasey. In wet places in the mountains of Colo.,

N. M., Ariz. and Mex.—Alt. about 7500 ft.—Mountains, Larimer Co.; La-Veta.

5. *Muhlenbergia cuspidata* (Torr.) Rydb. (*Vilfa cuspidata* Torr.; *Sporobolus cuspidatus* Woods) On dry plains from Man. to Alb., Mo. and Colo.—Exact locality not given.

6. *Muhlenbergia Thurberi* Rydb. (*Vilfa filiculmis* Thurber; *Sporobolus filiculmis* Vasey; not Dewey) Cañons and dry plains from Colo. to W. Tex. and N. M.—Alt. up to 9500 ft.—Cañons west of Ouray.

7. *Muhlenbergia Richardsonis* (Trin.) Rydb. (*Vilfa Richardsonis* Trin.; *Sporobolus depauperatus* Coulter in part) On prairies and in meadows from Anticosti to B. C., N. M. and Calif.—Alt. 4000-9000 ft.—Arboles; Georgetown; Durango; Mancos; Gunnison; Elk River, Routt Co.; Grizzly Creek; West Mancos Cañon; North Park; Mountain View, Pike's Peak; Twin Lakes; Colorado Springs; South Park; Alamosa; Como.

8. *Muhlenbergia simplex* (Scribn.) Rydb. (*Sporobolus simplex* Scribn.) In meadows and along brooks from Nebr. to Wyo. and N. Mex.—Alt. 8000-10,000 ft.—Georgetown; mountains between Sunshine and Ward; Twin Lakes; southeast of Jefferson, South Park; Crystal Park.

9. *Muhlenbergia filiformis* (Thurber) Rydb. (*Vilfa depauperate filiformis* Thurber) In wet places from Wyo. and Ore. to Colo. and Calif.—Steamboat Springs, Routt Co.

10. *Muhlenbergia aristata* Rydb. (*Sporobolus aristatus* Rydb.) Perhaps only a variety of the preceding. In wet places from Wyo. to Utah and Colo.—Alt. about 8500 ft.—Columbine.

11. *Muhlenbergia Wolfii* (Vasey) Rydb. (*Sporobolus Wolfii* Vasey) On wet shores in the mountains of Colo.—Alt. 9000-10,000 ft.—South Park; Twin Lakes; Halfway House.

12. *Muhlenbergia gracilis* Trin. On gravelly or sandy soil in the mountains from Tex. to Colo. and Calif.; also Mexico.—Alt. 5000-10,000 ft.—Monument Park; Georgetown; Twin Lakes; Ruxton Dell; cañon northeast side of Cheyenne Mountain; vicinity of Boulder; Como; Home; Buena Vista; Jefferson, South Park; Manitou; Colorado Springs; Cheyenne Cañon; Clear Creek; Georgetown; Bosworth's ranch, Stove Prairie; gulch west of Soldier Cañon; southeast of Jefferson, South Park; Middle Park; Ute Pass; Empire.

13. *Muhlenbergia subalpina* Vasey. (*M. gracilis breviaristata* Vasey) On dry hills from Wyo. to N. M.—Alt. about 10,000 ft.—Estes Park, Larimer Co.; Beaver Park; Twin Lakes; Ute Pass; Como.

14. *Muhlenbergia filiculmis* Vasey. Perhaps only a depauperate alpine form of the preceding. Mountains of Colo.—Alt. 8500 ft.—Green Mountain Falls; Como.

15. *Muhlenbergia gracillima* Torr. On plains and foot-hills and in cañons from Kans. to Colo., Tex. and N. M.—Alt. 4000-10,000 ft.—Huerfano; Manitou; Fort Collins; along the Platte River, near Denver; Colorado Springs; Twin Lakes; Timnath; near Owl Cañon.

16. *Muhlenbergia pungens* Thurb. BLOW-OUT GRASS. On sand-hills and "bad-lands" from Neb. to Utah.—Alt. 4000-10,000 ft.—Twin Lakes; Sterling, Logan Co.

17. *Muhlenbergia Porteri* Scribn. (*M. Texana* Thurb.; not Buckl.) On hills and plains from Tex. to Colo. and Calif.; also Mex.—Alt. about 6500 ft.—Cañon City.

21. **LYCURUS** H. B. K.

1. *Lycurus pheoides* H. B. K. On dry hillsides from Tex. to Colo. and Ariz.; also Mex.—Alt. 6000–7500 ft.—Garden of the Gods; Meadow Park; gulch west of Soldier Cañon.

22. **PHLEUM** L. TIMOTHY.

Spikes usually elongated-cylindric; awns less than $\frac{1}{2}$ the length of the outer glumes.

Spikes short, ovoid or oblong; awn about $\frac{1}{2}$ the length of the outer glume.

1. *P. pratense*.

2. *P. alpinum*.

1. *Phleum pratense* L. In meadows and waste places, escaped from cultivation from N. Sc. to B. C., Fla. and Calif.—Alt. up to 11,000 ft.—Pagosa Springs; Alpine Tunnel; Ruxton Park; Mancos.

2. *Phleum alpinum* L. In mountain meadows from Lab. to Alaska, N. H. and Calif.; also in northern Europe and Asia.—Alt. 8500–12,000 ft.—Near Pagosa Peak; Dead Lake; Ruxton Park; mountains west of Cameron Pass; Chamber's Lake; LaPlata; Georgetown; Seven Lakes; West Indian Creek; Lake City; Robinson, Summit Co.; Gray's Peak; Beaver Creek; Boreas; Hematite; Pike's Peak.

23. **ALOPECURUS** L. FOXTAIL.

Spike elongated-cylindric, 3–7 cm. long; 4–6 mm. in diameter.

Spike oblong, 2–4 cm. long; 9–12 mm. in diameter.

1. *A. aristulatus*.

2. *A. occidentalis*.

1. *Alopecurus aristulatus* Michx. In wet meadows from Me. to Alaska, Pa. and Calif.—Alt. 4000–11,500 ft.—Wahatoya Creek; Colorado Springs; Arboles; Laramie River, Larimer Co.; Grizzly Creek; Mancos; Dead Lake; vicinity of Boulder; Manitou; Twin Lakes; South Park; Tobe Miller's ranch, near La Porte; Quimby; Barne's Camp; Spring Cañon; Soda Creek; Poudre Cañon; Hotchkiss; Table Rock; Fossil Creek; along Purgatory River, near Trinidad.

2. *Alopecurus occidentalis* Scribn. (*A. alpinus* of Coult. Man.; not L.) In wet meadows from Alb. to B. C., Colo. and Utah.—Alt. 8500–11,000 ft.—Cameron Pass; Marshall Pass.

24. **PHIPPSIA** R. Br.

1. *Phippsia algida* R. Br. In arctic-alpine localities from Greenl. to Alaska; also in Colo., arctic Europe and Asia.—Chicago Lake, near Georgetown.

25. **BLEPHARINEURON** Nash.

1. *Blepharineuron tricholepis* (Torr.) Nash. (*Sporobolus tricholepis* Torr.) Mountain valleys from Colo. to Utah, Tex. and Ariz.; also Mex.—

Alt. 6000-12,000 ft.—Near Pagosa Peak; Ruxton Park; Mount Ouray; Montezuma; Ruxton Dell; Ribbon Lake; South Park; Colorado Springs; Minnehaha; Hinsdale Co.; Middle Park; southeast of Jefferson, South Park; Pagosa Peak.

26. **SPOROBOLUS** R. Br. DROPSEED, POVERTY-GRASS, WIRE-GRASS.

Perennials.

First glume one-half as long as the second or less; plant not with long, scaly root-stocks.

Branches of the panicle verticillate.

1. *S. argutus*.

Branches of the panicle scattered.

Spikelets about 2 mm. long; first glume lanceolate.

Sheath naked or sparingly ciliate at the throat; empty glumes glabrous.

2. *S. airoides*.

Sheath with a conspicuous tuft of hairs at the throat; empty glumes scabrous on the keel.

Leaf-blades 6 cm. long or less, widely spreading, involute; sheath pubescent with long hairs, at least towards the base.

3. *S. Nealeyi*.

Leaf-blades not widely spreading; sheaths glabrous, except the apex, and slightly on the margins.

Panicle usually more or less included in the sheaths; its lower branches much exceeding the upper ones.

4. *S. cryptandrus*.

Panicle always exserted, oblong, comparatively narrow; its lower branches but little, if any, exceeding the upper ones.

5. *S. flexuosus*.

Spikelets 4.5-5 mm. long; first glume subulate, usually awned.

6. *S. heterolepis*.

First glume almost equalling the second; plants with long, scaly root-stocks.

7. *S. asperifolius*.

Annuals; empty glumes almost equal, ovate.

8. *S. confusus*.

1. *Sporobolus argutus* (Nees) Kunth. On the plains from Kan. to Colo., Tex. and Mex.; also West Indies.—Exact locality not given (*Vasey*).

2. *Sporobolus airoides* Torr. Dry prairies and river-valleys from Neb. to Tex. and Calif.—Alt. 4000-11,000 ft.—Cañon City; Marshall Pass; South Park; Mancos; Fort Collins; Doyles; Arboles; Colorado Springs; La Porte; Palisade, Mesa Co.; Grand Junction; Alamosa; Cottonwood Creek; Gunnison.

3. *Sporobolus Nealeyi* Vasey. In dry places from Tex. to Colo. and N. M.—Alt. about 7500 ft.—Vicinity of Alamosa.

4. *Sporobolus cryptandrus* (Torr.) Gray. In sandy soil from Mass. to Wash., Pa., Tex., Ariz. and Ore.—Alt. 4000-8000 ft.—Cañon City; Empire; Manitou; Denver; Deer Run; plains and foot-hills, near Boulder; Colorado Springs; Fort Collins; Salida, Chaffee Co.; La Veta; Georgetown; Spring Cañon; Poudre Cañon; gulch, west of Soldier Cañon.

5. *Sporobolus flexuosus* (Thurber) Rydb. (*S. cryptandrus flexuosus* Thurber.) In sandy places from Tex. to Nev. and Mex.—Reported from Colorado, but doubtful.

6. *Sporobolus heterolepis* A. Gray. On dry prairies from Que. to Sask., Pa. and Colo.—Exact locality not given.

7. *Sporobolus asperifolius* (Nees & Mey.) Thurber. On dry prairies from Ass. to B. C., Mo., Tex. and Calif.—Alt. 4000-7500 ft.—Cottonwood Creek;

Saguache Creek; Fort Collins; Denver; Durango; vicinity of Boulder; Gunnison; Cottonwood Creek; Manitou; Grand Junction.

8. *Sporobolus confusus* Vasey. (*S. ramulosus* of Coult. Man.; not Kunth.) In wet, sandy places from Neb. to Mont., Tex. and Ariz.; also in Mex.—Alt. 4000–8500 ft.—Colorado Springs; Saguache Creek; Cimarron; Minnehaha; Ouray; Gunnison; Piedra; Buena Vista; mountains of Larimer Co.; Twin Lakes; Alamosa; vicinity of Fort Collins; Table Rock.

27. **POLYPOGON** Desf. BEARD-GRASS.

1. *Polypogon monspeliensis* (L.) Desf. In waste places from N. H. to B. C., S. C. and Calif.—Alt. about 5000 ft.—Fort Collins; Poudre River.

28. **CINNA** L. WOOD REED-GRASS.

1. *Cinna latifolia* (Trev.) Griseb. (*C. pendula* Trin.) In damp woods from Newf. to B. C., N. C. and Utah.—Alt. 4000–7500 ft.—Empire; Buffalo Pass road, Routt Co.; Idaho Springs; Salida.

29. **AGROSTIS** L. RED-TOP, HERD-GRASS, TIORIN, BENT-GRASS, HAIR-GRASS, TICKLE-GRASS.

Palet conspicuous, at least one-third as long as the flowering glume.

Panicle large; branches verticillate; spikelets about 3 mm. long; stem 3–10 dm. high.

1. *A. alba*.

Panicle small and narrow; branches scattered or in pairs; spikelets about 2 mm. long; stem 0.6–3 dm. high.

2. *A. depressa*.

Palet minute or wanting.

Branches of the contracted panicle short, at least some of them spikelet-bearing to the base.

3. *A. asperifolia*.

Branches of the panicle more slender, naked below.

Flowering glume awnless or short-awned; the awn not exceeding the spikelet.

Branches of the panicle filiform, branched far above the middle, at last divaricate or reflexed; plant usually over 3 dm. high.

4. *A. hiemalis*.

Branches short, 1–3 cm. long, ascending; plant 1–3 dm. high.

5. *A. tenuiculmis*.

Flowering glume with a long, bent awn, which exceeds the spikelet by one-half.

6. *A. canina* L.

1. *Agrostis alba* L. In wet meadows from Newf. to B. C., Fla. and Calif.; native also of Europe and cultivated.—Alt. 4000–8500 ft.—Gunnison; Golden; Fort Collins; Engelmann Cañon; Georgetown; Ouray; Twin Lakes; Manitou; gulch west of Soldier Cañon; Baxter's ranch.

2. *Agrostis depressa* Vasey. In wet mountain meadows and along brooks from Wyo. to Utah and Colo.—Alt. 9000–11,000 ft.—Georgetown; Beaver Creek.

3. *Agrostis asperifolia* Trin. (*A. exarata* Coulter, in part) In wet meadows from Man. to N. M. and Calif.—Alt. 4000–10,500 ft.—Beaver Creek; near Pagosa Peak; Arboles; along the Lower Cucharas River; Twin Lakes; Fort Collins; gulch west of Soldier Cañon.

4. *Agrostis hiemalis* (Walt.) B. S. P. (*A. scabra* Willd.) On prairies and hills, both in dry and wet soil, from Lab. to Alaska, Fla. and Calif.; also in Mex.—Alt. 4000–11,000 ft.—Vicinity of Fort Collins; Baxter's ranch; Poudre Cañon; Twin Lakes; Taylor River; about Ouray; Gunnison; North Cheyenne Cañon; Ruxton Dell; Pagosa Springs; near Pagosa Peak; near Boulder; mountains between Sunshine and Ward; Cameron Pass; Estes Park; Grand Lake; Hamor's Lake; Grizzly Creek; Georgetown; mountains, Larimer Co.; Marshall Pass; Valley and Empire; Veta Pass; Salida; Twin Lakes; South Park; Como; gulch west of Soldier Cañon; Little Beaver Creek; between Graymont and Silver Plume; Steamboat Springs; Rabbit-Ear Range.

5. *Agrostis tenuiculmis* Nash. (*A. tennis* Vasey) In mountain meadows from Mont. to Wash., Colo. and Calif.—Alt. 10,000–11,500 ft.—South Park; Mt. Elbert; Dead Lake; near Pagosa Peak; summit of North Park Range, Routt Co.

6. *Agrostis canina* L. Along mountain brooks from Newf. and Alaska to Pa., Colo. and Nev.—Alt. about 9000 ft.—Silver Plume.

30. CALAMAGROSTIS Adans. REED-GRASS, BLUE-JOINT.

Awn strongly geniculate, exserted, longer than the empty glumes; callus-hairs much shorter than the flowering glume; panicle dense and spike-like.

1. *C. purpurascens*.

Awn straight or nearly so, included; callus-hairs not much shorter than the flowering glume (except in *C. scopulorum*).

Panicle open, the lower branches wide-spreading and often drooping; leaf-blades flat; callus-hairs copious, almost equalling the glume.

Spikelets 4–6 mm. long; empty glumes narrow, sharply acuminate; awn stout, attached below the middle, considerably exceeding the glume.

2. *C. Langsdorffii*.

Spikelets 3–4 mm. long, awn attached near the middle, equalling or slightly exceeding the glume.

3. *C. canadensis*.

Panicle more or less contracted, branches ascending.

Leaf-blades flat or nearly so.

Callus-hairs copious, $\frac{2}{3}$ as long as the flowering glume or longer.

Plant caespitose; empty glumes acute.

9. *C. hyperborea elongata*.

Plant not caespitose; empty glumes long-acuminate.

4. *C. Scribneri*.

Callus-hairs sparse, $\frac{1}{2}$ as long as the glume.

5. *C. scopulorum*.

Leaf-blades involute.

Culm and the narrow leaf-blades soft, not rigid; plant not caespitose.

Spikelets 2.5–4 mm. long; empty glumes thin, sharp-acuminate.

6. *C. neglecta*.

Spikelets 2 mm. long; empty glumes thickish, barely acutish.

7. *C. micrantha*.

Culm and the usually broader leaf-blades hard, more or less rigid.

Plant not caespitose, tall; panicle very long.

8. *C. inexpansa*.

Plant strongly caespitose; panicle short and dense.

9. *C. hyperborea*.

1. *Calamagrostis purpurascens* R. Br. (*Deyeuxia sylvatica* Vasey; not DC.) On dry, stony hills and alpine table-lands from Greenl. to Alaska, Colo. and Calif.—Alt. 6500–12,500 ft.—Silver Plume; mountains above Idaho Springs; mountains between Sunshine and Ward; South Park; Mt. Ouray; Mt. Garfield; Georgetown; Front Range, Larimer Co.; Webster; Pike's Peak;

Stove Prairie Hill, Larimer Co.; mountains of Estes Park; Buena Vista; Clear Creek; near Chambers' Lake; Como; above Beaver Creek; Happy Hollow; Devil's Causeway; Graymont.

2. *Calamagrostis Longsdorffii* (Link.) Trin. (*D. Longsdorffii* Trin.) In wet meadows and open woods from Greenl. to Alaska, N. C. and Calif.—East of Laramie River, Larimer Co.

3. *Calamagrostis canadensis* (Michx.) Beauv. (*D. Canadensis* Munro.) In wet thickets and open woods; also in meadows from Lab. to B. C., N. C. and Calif.—Alt. 4000–11,000 ft.—Fremont Co.; Middle Park; near Pagosa Peak; Engelmann Cañon; Red Mountain, south of Ouray; Alpine Tunnel; Georgetown; Rabbit-Ear Pass; mountains and cañons, west of Palmer Lake; Estes Park; vicinity of Pike's Peak; Gunnison; Buena Vista; Veta Pass; vicinity of Ft. Collins; Table Rock; Barnes' Camp; Elk Cañon.

C. canadensis acuminata Vasey is a variety approaching the preceding species, in having larger flowers and more acuminate glumes. It has the same range as the species.—Alt. 9000–10,000 ft.—Near Pagosa Peak; Anita Peak.

4. *Calamagrostis Scribneri* Beal. In open marshes and wet meadows from Alb. to B. C., Colo. and Wash.—Alt. about 9000 ft.—Near Pagosa Peak.

5. *Calamagrostis scopulorum* M. E. Jones. Among rocks in Utah and Colo.—Alt. about 9000 ft.—Near Pagosa Peak.

6. *Calamagrostis neglecta* (Ehrh.) Gaertn. In open meadows from Lab. to Alaska, Me. and Colo.—Alt. 8000–9000 ft.—Georgetown; Iron-ton Park; Twin Lakes.

7. *Calamagrostis micrantha* Kearney. In wet meadows from Ass. to Colo.—Alt. about 8500 ft.—Steamboat Springs.

8. *Calamagrostis inexpansa* A. Gray. In wet meadows and swamps from N. Y. to Ida., N. J. and Colo.—Alt. about 8000 ft.—Penn's Gulch.

9. *Calamagrostis hyperborea* Lange. (*D. stricta* Am. auth. in part.) On sandy shores and among rocks, from Greenl. to Alaska, Vt. and Calif.—Alt. 4000–8500 ft.—Clear Creek; Hamor's Lake; Georgetown; Twin Lakes.

The following varieties are recognized by Kearney:

C. hyperborea stenodes Kearney, with narrow, strongly involute leaves, narrow panicle and smaller (3–3.5 mm. long), less scabrous empty glumes. In swamps from Ass. to Mont. and Colo.—Alamosa; South Park.

C. hyperborea elongata Kearney, with broader, often flattened, leaves and large, often interrupted, panicle. In wet meadows and swamps, especially in the plain regions, from Ont. to B. C., Colo. and Calif.—Veta Pass; Penn's Gulch; Gunnison; Fort Garland.

C. hyperborea americana (Vasey) Kearney, with shorter, merely acute, empty glumes and short dense inflorescence. In meadows and on prairies from Vt. to B. C., Colo. and Ore.—Breckenridge; Durango.

31. CALAMOVILFA Hack. REED-GRASS, SAND-GRASS.

1. *Calamovilfa longifolia* (Hook) Hack. (*Calamagrostis longifolia* Hook.) On sandy shores and sand-hills, from Ont. and Man. to Ind. and Colo.—Alt. 4000–5000 ft.—Tobe Miller's ranch, near La Porte; vicinity of Fort Collins.

Tribe 7. AVENEAE.

32. DESCHAMPSIA Beauv. HAIRGRASS.

Empty glumes not extending beyond the apex of the upper flowering glume; leaves narrow.

Empty glumes 4-5 mm. long; awn from half longer than to twice as long as the flowering glume. 1. *D. alpicola*.

Empty glumes 3-4 mm. long.

Awn about half longer than the flowering glume; leaves short, almost filiform; plant 2-3 dm. high. 2. *D. curtifolia*.

Awn slightly if at all exceeding the flowering glume; leaves long and firm; plant usually 3-8 dm. high. 3. *D. caespitosa*.

Empty glumes much exceeding the upper flowering glume; leaves broad.

4. *D. atropurpurea*.

1. *Deschampsia alpicola* Rydb. (*D. caespitosa alpina* Vasey; not *D. alpina* R. & S.) In alpine meadows and on slopes, from Colo. to southern Wyo. and Utah; a similar, if not identical, form in Alaska.—Alt. 9000-14,000 ft.—Bert-houd's Pass; Twin Lakes; Pike's Peak; Silver Plume; South Park; near Pagosa Peak; East River; Seven Lakes; Mt. Ouray; Georgetown; Cache la Poudre, Larimer Co.; Tennessee Pass; Dead Lake; vicinity of Gray's Peak; Clear Creek; Cameron Pass; Gray's Peak; Ethel Peak, Larimer Co.

2. *Deschampsia curtifolia* Scribn. (*D. brachyphylla* Nash, in part.) On wet alpine slopes from Mont. to Colo.—Alt. 11,000-12,000 ft.—Little Kate Mine, La Plata Mountains; crater of Mt. Richtofen.

3. *Deschampsia caespitosa* (L.) Beauv. In wet meadows and swamps from Newf. to Alaska, N. J. and Calif.—Alt. 7500-11,000 ft.—Twin Lakes; George-town; Pagosa Springs; Cache la Poudre, Larimer Co.; Hamor's Lake; North Park; Gunnison; Marshall Pass; Ruxton Park; Grizzly Creek; Steamboat Springs; Silver Plume; Pike's Peak; Como; North Park; Deadman Cañon; near Chambers' Lake; Fort Collins; Barnes' Camp; Ragged Mountains, Gun-nison Co.; Hahn's Peak, Routt Co.; summit of North Park Range.

4. *Deschampsia atropurpurea* (Wahl.) Scheele. In alpine and subarctic meadows from Lab. to Alaska, northern N. Y. and Calif.—Alt. about 10,000 ft.—Buffalo Pass, near Divide, Routt Co.

33. TRisetum Pers. FALSE OATS.

Leaf-sheaths and blades long-hairy; upper part at the stem densely pubescent.

1. *T. subspicatum*.

Leaf-sheaths and blades glabrous or the lowest sheath short-pubescent, with reflexed hairs; stem glabrous or slightly scabrous in the inflorescence.

Inflorescence long, dense, cylindric; lower empty glume only slightly narrower than the upper; leaf-blades not much broader than the sheaths and without conspicuous auricles. 2. *T. majus*.

Inflorescence lanceolate, open; lower empty glume scarcely more than half as broad as the upper; leaf-blades much broader than the sheaths and there-fore with conspicuous auricles at the base. 3. *T. montanum*.

1. *Trisetum subspicatum* (L.) Beauv. (*T. subspicatum molle* Coult.) On mountains and hillsides from Greenl. to Alaska, N. H., Colo. and Calif.; also in northern Europe.—Alt. 10,000-13,000 ft.—Twin Lakes; Valley Spur; Seven Lakes; Georgetown; Gray's Peak; Cameron Pass; Pike's Peak; Dead

Lake; Windy Point; Ironton, San Juan Co.; Mt. Bartlett; Devil's Causeway; mountains above Graymont; along the Michigan, North Park; Ethel Peak, Larimer Co.

2. *Trisetum majus* (Vasey) Rydb. (*T. subspicatum major* Vasey; *T. subspicatum* Coult., mainly; not Beauv.) In meadows and on hillsides from Mont. to B. C., Colo. and Utah.—Alt. 8000–12,000 ft.—Below Berthoud's Pass; Middle Park; near Pagosa Peak; Mt. Baldy; Pike's Peak; Marshall Pass; Cumberland Mine; Ironton, San Juan Co.; Cameron Pass; Idaho Springs; Georgetown; Cache la Poudre, Larimer Co.; Upper La Plata; Seven Lakes; North Park; Trapper's Lake; near Chambers' Lake; along Michigan, North Park; Ute Pass.

3. *Trisetum montanum* Vasey. In moist places, especially among bushes from southern Wyo. to N. M.—Alt. 7500–10,000 ft.—Twin Lakes; near Pagosa Peaks; vicinity of Ouray; Minnehaha; Idaho Springs; Ruxton Creek; Villa Grove, Saguache Co.; Beaver Creek; Cameron Pass.

34. GRAPHEPHORUM Desv.

Empty glumes equal or nearly so, 6–7 mm. long.

1. *G. muticum*.

Empty glumes unequal; the lower 3–4 mm. long, the upper 4–5 mm.

Inflorescence open; culm minutely pubescent at the nodes; rachilla short-hairy.

2. *G. Shearii*.

Inflorescence narrow; culm perfectly glabrous; rachilla long-hairy.

3. *S. Wolfii*.

1. *Graphephorum muticum* (Boland.) Scribn. (*G. melicoides* Coult.; not Beauv.) In wet meadows from Alb. to Wash., Colo. to Calif.—Alt. 9000–10,500 ft.—Near Ironton, San Juan Co.; Marshall Pass; headwaters of Pass Creek; Cumbres; Barnes' Camp; along Walton Creek; Ute Pass road; Cameron Pass.

2. *Graphephorum Shearii* (Scribn.) Rydb. (*Trisetum argenteum* Scribn.; not R. & S.; *T. Shearii* Scribn.) Among rocks at an altitude of 9000 ft.—Las Animas Cañon, below Silverton.

3. *Graphephorum Wolfii* Vasey. (*T. Wolfii* Vasey.) In wet places in willow thickets.—Alt. about 10,500 ft.—Twin Lakes; Cameron Pass.

35. AVENA L. OATS, OAT-GRASS.

Empty glumes shorter than the flowering glumes; panicle lax, narrow and somewhat nodding; flowering glume hairy at the base.

1. *A. striata*.

Empty glumes longer than the flowering glumes.

Panicle narrow and spike-like, strict; empty glumes 8–14 mm. long; flowering glumes hairy only at the base.

Plant 1–1.5 dm. high; leaves strongly involute; callus of the flowering glume and prolongation of the rachilla long-hairy.

2. *A. Mortoniana*.

Plant 2–4 dm. high; leaves mostly flat; callus and prolongation of the rachilla short-hairy.

3. *A. americana*.

Panicle open; empty glume over 2 cm. long; flowering glumes often hairy up to the base of the awn.

4. *A. fatua*.

1. *Avena striata* Michx. In woods from N. B. to B. C., Pa. and Colo.—Alt. 7000–11,000 ft.—Crystal Park; mountains, Larimer Co.; Little Kate Mine, La Plata Mountains; Pennock's mountain ranch.

2. *Avena Mortoniana* Scribn. On mountain tops of Colo.—Alt. 13,000–14,000 ft.—Mountains near Silver Plume; Gray's Peak; Robinson, Summit Co.; Cameron Pass; Beaver Creek; Mt. Garfield.

3. *Avena americana* Scribn. On ridges and hillsides from Sask. to Alb., S. D. and Colo.—Alt. about 10,000 ft.—Ruxton Dell.

4. *Avena fatua* L. WILD OATS. Naturalized from Europe and Asia, in grain fields from Minn. to B. C., Colo. and Calif.—Alt. about 5000 ft.—Fort Collins.

36. *DANTHONIA* DC. WILD OAT-GRASS.

Flowering glume pubescent only on the margin and at the base.

Spikelets on slender, spreading and somewhat drooping pedicels; stem leafy throughout.

Spikelet on short erect pedicels in a dense, spike-like inflorescence; stem naked above.

Flowering glumes hairy on the back as well as on the margins and base; inflorescence spike-like, with short, erect branches.

Empty glumes 15–20 mm. long.

Empty glumes 10 mm. or less long.

1. *D. californica*.

2. *D. intermedia*.

3. *D. Parryi*.

4. *D. spicata*.

1. *Danthonia californica* Bolander. In wet meadows from Mont. to B. C., Colo. and Calif.—Alt. 5000–10,000 ft.—Steamboat Springs; along the Michigan, North Park; pasture, Walton Creek flats; Arapahoe Pass.

2. *Danthonia intermedia* Scribn. In meadows and on mountain slopes from Alb. to B. C., Colo. and Calif.—Alt. 9000–11,500 ft.—Silverton; Red Dirt Divide, Routt Co.; Middle Park; Dead Lake; near Pagosa Peak; Ruxton Dell; Rabbit-Ear Pass; Marshall Pass.

3. *Danthonia Parryi* Scribn. In mountain valleys from Alb. to N. M.—Alt. 8500–10,000 ft.—Twin Lakes; Empire City; South Park; Chicken Creek, west of Mt. Hesperus; Bear Creek Cañon; Georgetown; Ute Pass; Ruxton Dell; Dillon.

4. *Danthonia spicata* (L.) Beauv. In dry soil from Newf. to B. C., N. C., La. and Colo.—Alt. about 6500 ft.—North Cheyenne Cañon.

Tribe 8. *CHLORIDEAE*.

37. *SPARTINA* Schreb. MARSH-GRASS, CORD-GRASS.

First glume awn-pointed, equalling the third; second glume long-awned.

First glume acute, shorter than the third; second glume acute.

1. *S. cynosuroides*.

2. *S. gracilis*.

1. *Spartina cynosuroides* (L.) Willd. In swamps and streams from N. S. to Mackenzie River, N. J., Tex. and Colo.—Alt. 4000–6000 ft.—Near Boulder; Fort Collins; Tobe Miller's ranch; Poudre Cañon.

2. *Spartina gracilis* Trin. In saline or alkaline meadows from Sask. to B. C., Colo. and Ariz.—Alt. 4000–5500 ft.—Grand Junction; Sagauche Creek; Cañon City.

38. *BECKMANNIA* Host. SLOUGH-GRASS.

1. *Beckmannia erucaeformis* (L.) Host. In swamps and wet meadows from Ont. to Alaska, Iowa, Colo. and Calif.—Alt. 4000–9000 ft.—Gunnison;

Wahatoya Creek; Middle Park; near Denver; Trimble Springs; North Park; Sangre de Cristo Creek; Saguache Creek; Fort Collins; Chambers' Lake; Larimer Co.; Fort Collins.

39. **SCHEDONARDUS** Steud. WILD CRAB-GRASS.

1. *Schedonardus paniculatus* (Nutt.) Trelease. (*S. Texanus* Steud.) In sandy soil, especially on river-banks from Ill. and Man. to Ass., Tex. and N. M.—Alt. 4000–6000 ft.—Vicinity of Boulder; New Windsor, Weld Co.; Fort Collins; Colorado Springs; vicinity of Pike's Peak; Arboles; Denver.

40. **BOUTELOUA** Lag. GRAMA, MESQUIT-GRASS.

Spikelets usually more than one; caespitose perennials.

Awns manifestly arising from between the lobes of the flowering glumes.

1. *B. polystachya*.

Awns terminating the lobes of the flowering glumes.

Stem densely villous below.

2. *B. eriopoda*.

Stem glabrous.

Rachilla bearing the rudimentary glumes and awns glabrous; second glume strongly papillose-hispid on the keel.

3. *B. hirsuta*.

Rachilla bearing the rudimentary glumes and awns with a tuft of long hairs at the apex; second glume scabrous and sparingly long-ciliate on the keel.

4. *B. oligostachya*.

Spikelet solitary; tufted annual.

5. *B. prostrata*.

1. *Bouteloua polystachya* (Benth.) Torr. In river-valleys from Tex. to Calif.—San Juan and Mancos Valleys (*Brandege*).

2. *Bouteloua eriopoda* Torr. In dry soil from Tex. to Calif.—San Juan Valley (*Brandege*).

3. *Bouteloua hirsuta* Lag. On plains and prairies, especially in sandy soil, from Ill. and Minn. to S. D., Tex. and Ariz.—Alt. 4000–7000 ft.—Vicinity of Boulder; Twin Lakes; Manitou; Colorado Springs; Meadow Park.

4. *Bouteloua oligostachya* (Nutt.) Torr. On plains and prairies from Wis. and Man. to Ass., Miss. and Ariz.; also in Mex.—Alt. 4000–8000 ft.—Vicinity of Boulder; New Windsor, Weld Co.; Buena Vista; Fort Collins; Denver; Mancos; Durango; Fort Morgan; Georgetown; Walsenburg; Gunnison; Colorado Springs; Twin Lakes; Fort Garland; between Ft. Collins and La Porte; Alamosa; Poudre Cañon; Baxter's ranch; prairie near Long Lake; Rocky Ford.

5. *Bouteloua prostrata* Lag. Plains and hills from Tex. to Colo. and Ariz.; also in Mex.—Alt. 7500–8500 ft.—Colorado Springs; vicinity of Ouray; Manitou.

41. **ANTHEROPOGON** Muhl.

1. *Antheropogon curtipendulus* (Michx.) Fourn. (*Bouteloua racemosa* Lag.) On hillsides, in cañons and dry valleys from Ont. to N. D., N. J., Tex. and Ariz.; also in Mex.—Alt. 4000–7000 ft.—Vicinity of Boulder; Manitou; foot-hills, Larimer Co.; Meadow Park; Durango; Walsenburg; Fort Collins; Colorado Springs; gulch west of Soldier Cañon; Poudre Cañon.

42. **LEPTOCHLOA** Beauv.

1. *Leptochloa mucronata* (Michx.) Kunth. In fields from Va. to Colo., Fla. and Calif.—Locality not given (*Letterman*).

43. **BULBILIS** Raf. BUFFALO-GRASS.

1. *Bulbilis dactyloides* (Nutt.) Raf. (*Buchloe dactyloides* (Nutt.) Engelm.) On prairies and plains from Minn. to N. D., Wyo., Ark. and N. Mex.; also Mex.—Alt. 4000–6000 ft.—Vicinity of Boulder; New Windsor, Weld Co.; plains near Denver; Fossil Creek, Larimer Co.; Fort Collins; Quimby; Spring Cañon.

Tribe 9. **FESTUCEAE.**44. **SCHLEROPOGON** Philippi.

1. *Schleropogon brevifolius* Philippi. On rocky ridges from Tex. to Colo. and Ariz.—Alt. about 5000 ft.—Pueblo.

45. **PHRAGMITES** Trin. REED.

1. *Phragmites Phragmites* (L.) Karst. (*P. communis* Trin.) In lakes and swamps from Newf. to B. C., Fla. and Calif.; also in Mex., W. Ind., Europe and Asia.—Alt. 4000–6000 ft.—Hotchkiss, Delta Co.; LaSalle; Deer Run; Loveland, Larimer Co.; along lower Cucharas River.

46. **MUNROA** Torr. FALSE BUFFALO-GRASS.

1. *Munroa squarrosa* (Nutt.) Torr. On dry plains from N. D. to Ass., Tex. and Ariz.—Alt. 4000–8500 ft.—Boulder City; Fort Collins; plains near Denver; Manitou; Black Cañon; New Windsor, Weld Co.; near Golden; Idaho Springs; Colorado Springs; Salida; valley north of Georgetown; gulch west of Soldier Cañon; Florence; Boulder; Lafayette.

47. **TRIPLASIS** Beauv. SAND-GRASS.

1. *Triplasis purpurea* (Walt.) Chapm. On sandy beaches from Ont. to Neb., Fla. and Tex.—Locality not given (*Hall and Harbour*).

48. **DASYOCHLOA** Willd.

1. *Dasyochloa pulchella* (H. B. K.) Willd. (*Triodia pulchella* Willd.) On hills and plains from Wyo. to Tex. and Calif.; also in Mex.—San Juan Valley (*Brandege*).

49. **ERIONEURON** Nash.

1. *Erioneuron pilosum* (Buckley) Nash. (*Triodia acuminata* Benth.) In dry, gravelly soil from Kans. to Colo., Tex. and Ariz.—Alt. 4000–5500 ft.—Brantly Cañon, Las Animas Co.; Delta; Grand Junction; Cañon City; Pueblo; Royal Gorge; dry mesas, 9 miles above Delta.

50. **TRIDENS** R. & S.

Second empty glume 1-nerved.
Second empty glume 3-5-nerved.

1. *T. muticus*.
2. *T. elongatus*.

1. *Tridens muticus* (Torr.) Nash. (*Triodia mutica* Benth.) On dry hills from Tex. to Colo. and Ariz.; also northern Mex.—Cañon City (Porter).

2. *Tridens elongatus* (Buckley) Nash. On plains and prairies from Tex. to Colo. and Ariz.—Alt. about 5500 ft.—Pueblo; Cañon City.

51. **DIPLACHNE** Beauv.

1. *Diplachne acuminata* Nash. In wet places from Ark. to Neb. and Colo.—Alt. 4000-5500 ft.—New Windsor, Weld Co.; Cañon City.

52. **REDFIELDIA** Vasey.

1. *Redfieldia flexuosa* (Thurb.) Vasey. (*Graphephorum flexuosum* Thurb.) In sand-hills from S. D. to Ind. Terr. and Tex.—Alt. 4000-5500 ft.—Sterling, Logan Co.; Fort Garland.

53. **KOELERIA** Pers. PRAIRIE-GRASS, JUNE-GRASS.

1. *Koeleria cristata* (L.) Pers. On prairies and plains from Ont. to B. C., Pa. and Calif. A very variable species and perhaps a composite one. The form common in the Rocky Mountain region has narrow, involute, glabrous or puberulent leaves and narrow panicle, and has been described under the name *K. nitida* Nutt.—Alt. 4000-10,000 ft.—Middle Park; Pagosa Springs; vicinity of Boulder; foot-hills, Larimer Co.; Arboles; Gunnison; Sangre de Cristo Creek; Golden; Twin Lakes; Mancos; Crystal Park; Minnehaha; Cimarron; vicinity of Ouray; near Pike's Peak; Stove Prairie Hill, Larimer Co.; La Veta; Manitou; North Park; Happy Hollow; Hotchkiss; Horsetooth Gulch; Table Rock; Manitou Junction; Dixon Cañon; hills about Dolores; dry hills along Trail Creek; Como; Grizzly Creek; Fort Collins; Hardin's ranch; Willow Creek, Routt Co.

54. **ERAGROSTIS** Beauv. SKUNK-GRASS, STINK-GRASS.

Culm often decumbent at the base, much branched, 1-5 dm. high; annuals; panicle green.

Spikelets 1.5 mm. or less wide; palea remaining attached to the continuous rachis, after the flowering glume has fallen.

Spikelets 2.5-5 mm. wide; palea falling with the flowering glume and the internodes of the rachis.

Culm erect, rigid, simple; perennial; panicle purple.

1. *E. Purshii*.
2. *E. major*.
3. *E. pectinacea*.

1. *Eragrostis Purshii* Schrad. In dry or sandy places from Ont. to Wash., Fla. and Calif.—Alt. 4000-7500 ft.—Alamosa, Conejos Co.; Cañon City, Fremont Co.; along the river, Ft. Collins.

2. *Eragrostis major* Host. (*E. poaeoides megastachya* A. Gray.) Naturalized from Europe, in waste places and fields from Ont. to Wash., Fla. and Calif.—Alt. 4000-6000 ft.—Vicinity of Boulder; Longmont; New Windsor, Weld Co.; Cañon City, Fremont Co.; Cheyenne Mountain; Tobe Miller's ranch; near Ft. Collins.

3. *Eragrostis pectinacea* (Michx.) Steud. In sandy soil from Mass. and S. D. to Fla., Tex. and Colo.—Alt. 4000–5000 ft.—Meadow Park.

55. CATABROSA Beauv. WATER WHORL-GRASS.

1. *Catabrosa aquatica* (L.) Beauv. In water, where it is often floating, from Lab. to Alaska, Nebr., Colo. and Utah.—Alt. 5000–9500 ft.—Sangre de Cristo Creek; Rabbit-Ear Pass; Fort Collins; Breckenridge; near Gray's Peak; gulch west of Pennock's.

56. EATONIA Raf.

Second empty glume much wider than the flowering glumes, rounded or truncate and somewhat cucullate at the apex.

Intermediate nerves of the second glume almost as prominent as the lateral ones; leaf-blades firm, much broader than the sheaths and therefore with prominent auricles.

1. *E. robusta*.

Intermediate nerves of the second glume faint, the lateral strong; leaf-blades soft, not much wider than the sheaths; auricles not prominent.

2. *E. obtusata*.

Second empty glume not much wider if at all than the flowering glumes, obtuse or acute.

Second empty glumes rather firm, as well as the flowering glumes obtusish.

3. *E. intermedia*.

Second empty glume thin and with a broad, scarious margin, acutish; flowering glumes acute.

4. *E. pennsylvanica*.

1. *Eatonia robusta* (Vasey) Rydb. (*E. obtusata robusta* Vasey.) On river-banks from Neb. to Wash., N. M. and Ariz.—Alt. 4000–5000 ft.—Vicinity of Boulder; Rocky Ford.

2. *Eatonia obtusata* (Michx.) A. Gray. In meadows from Mass. to Mont., Fla. and Ariz.—Alt. 4000–6000 ft.—About Boulder; Manitou; gulch west of Soldier Cañon; near Timnath; Fort Collins; Hotchkiss, Delta Co.

3. *Eatonia intermedia* Rydb. In meadows from Alb. to Colo.—Alt. 5000–8000 ft.—Pagosa Springs; Durango; Gunnison.

4. *Eatonia pennsylvanica* (DC.) A. Gray. In open woods and among bushes from N. B. to B. C., Ga. and Colo.—Alt. 4000–7500 ft.—Vicinity of Pike's Peak; Arboles; Pagosa Springs; Alamosa.

57. MELICA L. MELIC-GRASS.

Stem not bulblike-thickened at the base.

1. *M. parviflora*.

Stem bulblike-thickened at the base.

Second empty glume much shorter than the flowering glume of the lowest flower; spikelets flattened.

2. *M. spectabilis*.

Second empty glume about equalling the flowering glume of the lowest flower; spikelets terete or nearly so.

3. *M. bulbosa*.

1. *Melica Porteri* Scribn. (*M. parviflora* (Porter) Scribn.) On hillsides and in cañons, especially among bushes, from Neb. to Colo., Tex. and Ariz.—Alt. 6000–9000 ft.—Cheyenne Cañon; mountains near Pagosa Peak; Engelmamm Cañon; vicinity of Ouray; Idaho Springs; Glen Eyrie; Upper La Plata; vicinity of Pike's Peak; Black Cañon; Manitou; vicinity of Pine Grove.

2. *Melica spectabilis* Scribn. In meadows from Mont. to Wash., Colo. and Oregon.—Alt. 8000-9000 ft.—Honnold; North Park; foot of Mt. Richtofen, on the Michigan; mountain west of Cameron Pass.

3. *Melica bulbosa* Geyer. In meadows and on hillsides from Mont. to Wash., Colo., Utah and Ore.—Rabbit-Ears, Larimer Co.; Glenwood Springs, Garfield Co. Osterhout's specimens (somewhat undeveloped) have unusually broad leaves and may belong to the closely related *M. californica* Scribn.

58. DACTYLIS L. ORCHARD-GRASS.

1. *Dactylis glomerata* L. Cultivated and naturalized from Europe; in fields and waste places from N. B. to Wash., Fla. and Calif.—Alt. 4000-9000 ft.—Cucharas River, below La Veta; Chicken Creek; Veta Pass, Costilla Co.; Fort Collins.

59. BRIZA L. QUAKING-GRASS.

1. *Briza maxima* L. Introduced ornamental grass, and escaped along irrigation ditches.—Alt. about 7500 ft.—Gunnison.

60. DISTICHLIS Raf. SALT-GRASS, MARSH SPIKE-GRASS.

1. *Distichlis stricta* (Torr.) Rydb. (*D. maritima stricta* Thurber.) In salt marshes from Sask. to Wash., Mo., Tex. and Calif.—Alt. 4000-7500 ft.—Grand Junction; Deer Run; New Windsor, Weld Co.; near Denver; Fort Collins; Saguache Creek; Alamosa; Pueblo; Rocky Ford.

61. POA L. BLUE-GRASS, MEADOW-GRASS, BUNCH-GRASS.

Annuals.

I. ANNUAE.

Perennials.

Cobweb at the base of the flowers present, although in some species scant; flowering glume acute (except in *P. compressa*), and usually strongly keeled; plants with horizontal rootstocks, never true bunch-grasses.

Intermediate nerves of the flowering glumes strong.

Inflorescence with numerous many-flowered spikelets; its branches in fruit ascending; the lower in 3's or 4's; flowering glumes acutish; cobweb copious.

II. PRATENSES.

Inflorescence with usually few-flowered spikelets; its branches reflexed or spreading in fruit; flowering glumes very acute.

Spikelets few and usually purplish; branches of the inflorescence few, solitary or in pairs, only in *P. callichroa* in 3's.

III. REFLEXAE.

Spikelets many, green; branches of the inflorescence many; the lower often in 3's or 4's.

IV. PLATYPHYLLAE.

Intermediate veins of the flowering glumes faint or obsolete.

Stem compressed; panicles narrow, open.

V. COMPRESSAE.

Stem not compressed.

Branches of the panicles reflexed.

VI. APERTAE.

Branches of the large panicle not reflexed.

Flowers green; nerves of the empty glumes strong; meadow species with flaccid leaves.

VII. SEROTINAE.

Flowers more or less purplish; nerves of the empty glumes usually faint; hill species with rather stiff leaves.

VIII. RUPICOLAE.

Cobweb at the base of the flowers none.

Spikelets rounded at the base; empty glumes very broad and their backs strongly arched; low, somewhat tufted plants, with short but open panicle and broad leaves. IX. ALPINAE.

Spikelets acute at the base; empty glumes narrower and not strongly arched on the back.

Flowering glumes 3-4 mm. long; low alpine plants with few, more or less purplish spikelets.

Branches of the inflorescence ascending.

VIII. RUPICOLAE.

Branches of the inflorescence spreading or reflexed. (*P. alpicola* in)

III. REFLEXAE.

Flowering glumes 5 mm. or more; plants comparatively tall or robust.

Spikelets decidedly flattened; flowering glumes acute.

Nerves and inter-nerves more or less hairy, at least below; flowers perfect.

Inflorescence open; plants with horizontal rootstocks; innovations (i. e., new shoots) extra-vaginal (except in *P. pseudopratenensis*).

Intermediate nerves of the flowering glumes faint; spikelets purplish. X. PHOENICEAE.

Intermediate nerves of the flowering glumes strong; spikelets green or slightly purple-tinged. XI. WHEELRIANAE.

Inflorescence narrow; plants more or less tufted, without creeping rootstock.

Leaves not filiform; innovations mostly extra-vaginal.

XII. EPILES.

Leaves filiform; plant true bunch-grasses with intra-vaginal innovations. XIII. FILIFOLIAE.

Nerves of the flowering glumes villous, but the inter-nerves glabrous; plants dioecious; bunch-grasses with intra-vaginal innovations.

XIV. FENDLERIANAE.

Spikelets only slightly flattened; flowering glumes narrow, nearly straight on the back, rounded at the apex; bunch-grasses with narrow panicles and intra-vaginal innovations. XV. BUCKLEYANAE.

I. ANNUAE.

Low, 1-2 dm. high; branches of the panicle spreading.

1. *P. annua*.

Taller, erect, 2-5 dm. high; branches of the panicle erect.

2. *P. Bigelovii*.

II. PRATENSES.

One very variable species.

3. *P. pratensis*.

III. REFLEXAE.

Cobweb present but scant.

Internerves of the flowering glumes more or less pubescent, at least below.

Spikelets 3-4-flowered; stem-leaves usually folded or involute; plant usually less than 3 dm. high.

Internerves of the flowering glumes short-pubescent below; leaves filiform, involute; those of the sterile shoots usually arcuate. 4. *P. cenisia*.

Internerves of the flowering glumes long-hairy; leaves 1-2 mm. wide, usually conduplicate, rather firm. 5. *P. arctica*.

Spikelets 5-7-flowered; leaves all flat, 3-4 mm. wide; stem fully 3 dm. high. 6. *P. callichroa*.

Internerves of the flowering glumes glabrous.

Intermediate nerves of the flowering glumes pubescent; plant 3 dm. or less high; leaves mostly basal, firm; stemleaves 1-2, usually conduplicate.

7. *P. pudica*.

Intermediate nerves of the flowering glumes glabrous; plant usually over 3 dm. high; stemleaves several, flat and flaccid.

Hairs of the mid-nerves and lateral nerves copious and spreading.

8. *P. reflexa*.

Hairs of the mid-nerves and lateral nerves few and appressed or none.

- Cobweb lacking; internerves and the intermediate nerves glabrous; mid-nerves and lateral nerves hairy; habit like *P. arctica*.
 9. *P. leptocoma*.
 10. *P. alpicola*.

IV. PLATYPHYLLAE.

One species.

11. *P. platyphylla*.

V. COMPRESSAE.

One species.

12. *P. compressa*.

VI. APERTAE.

Branches of the inflorescence short, usually in pairs.
 Branches of the inflorescence very long, in 3's to 5's.

13. *P. aperta*.
 14. *P. macroclada*.

VII. SEROTINAE.

- Stem stout; leaves 2-5 mm. wide; ligule 3-4 mm. long, triangular; branches of the panicle at last spreading; second glume narrower than the flowering glumes, $\frac{3}{4}$ as long or more.
 Stem slender; leaves seldom over 2 mm. wide; ligule about 1 mm. long, truncate; branches of the panicle ascending; second glume as wide as the flowering glumes and $\frac{3}{4}$ as long.
 Flowers green; empty glumes, especially the second, with broad, scarious margins and strong lateral nerves.
 Flowers usually purple-tinged; scarious margin of the empty glumes scarcely evident and lateral nerves faint.

15. *P. serotina*.
 16. *P. interior*.
 17. *P. crocata*.

VIII. RUPICOLAE.

- Mid-nerve and lateral nerves of the flowering glumes pubescent; plant strict, 1-5 dm. high.
 Empty glumes shorter than the flowering glumes; their lateral nerves indistinct.
 Cobweb at the base of the flowers scant; stem slender and leafy, usually 3-5 dm. high.
 Cobweb none; stem 1-2 (seldom 3) dm. high, leafy mostly at the base.
 Flowering glumes 3 mm. long or less, firm, obtuse.
 Flowering glumes about 4 mm. long, acute, thin.
 Empty glumes equalling or longer than the flowering glumes, *i. e.*, their tips almost as high as the tip of the subtended flowers; their lateral nerves more prominent.
 Nerves of the flowering glumes glabrous; plant seldom over 5 cm. high.

17. *P. crocata*.
 18. *P. rupicola*.
 19. *P. Pattersonii*.
 20. *P. Grayana*.
 21. *P. Lettermanii*.

IX. ALPINAE.

One species.

22. *P. alpina*.

X. PHOENICEAE.

One species.

23. *P. phoenicea*.

XI. WHEELERIANAE.

Leaf-sheaths retrorsely stigose.

- Internerves of the very acute flowering glumes merely strigulose or scabrous.
 Nerves scabrous.
 Nerves silky or villous on the lower portion.
 Internerves as well as nerves of the obtusish flowering glumes villous at least below.

24. *P. Wheeleri*.
 25. *P. Vaseyana*.
 26. *P. tricholepis*.

Leaf-sheaths glabrous.

- Internerves of the lanceolate flowering glumes scabrous or strigulose; innovations very few and consisting of wholly extravaginal runners.

27. *P. occidentalis*.

Internerves of the ovate flowering glumes pubescent; innovation several, both extra- and intra-vaginal. 28. *P. pseudopratisensis*.

XII. EPILE.

Flowering glumes about 5 mm. long, strongly purple-tinged, but slightly scabrous; stem-leaves broad. 29. *P. subpurpurea*.

Flowering glumes about 4 mm. long or less, usually greenish or slightly purple; stem-leaves narrow. 30. *P. epilis*.

XIII. FILIFOLIAE.

One species.

31. *P. nematophylla*.

XIV. FENDLERIANAE.

Ligules 5-7 mm. long, acute or acuminate.

32. *P. longiligula*.

Ligules short, rounded or truncate at the apex; those of the innovations obsolete.

Panicle very narrow and long-peduncled, contracted. 33. *P. longipedunculata*.
Panicle more open at least in anthesis.

Flowering glumes narrowly oblong; leaves very slender and rough.

34. *P. scabriuscula*.

Flowering glumes ovate.

Panicle very short; plant low; leaves smooth below, scabrous above.

35. *P. brevipaniculata*.

Panicle longer; plant 3-6 dm. high; leaves scabrous below, hispid-puberulent above.

36. *P. Fendleriana*.

XV. BUCKLEYANAE.

Internerves of the flowering glumes glabrous; nerves silky.

Plant low; leaves stiff, involute and often arcuate.

40. *P. juncifolia*.

Plant tall; leaves broad and flat.

37. *P. glaucifolia*.

Internerves of flowering glumes more or less scabrous or strigose.

Flowering glumes merely scabrous throughout.

Empty glumes strongly nerved, elongated lanceolate, almost equalling the oblong, very scabrous flowering glumes; leaves usually broad (2-3 mm.) and flat; ligules lanceolate, acute.

38. *P. nevadensis*.

Empty glumes not strongly nerved, ovate-lanceolate, usually much shorter than the flowering glumes, which are broader and less scabrous.

Ligules narrowly lanceolate, 3-4 mm. long, acuminate; stem-leaves very narrow and involute.

39. *P. laevigata*.

Ligules short, 1-2 mm. long, triangular or broadly ovate and acutish or truncate.

Plant 2-4 dm. high; leaves mostly basal and stiff, short, seldom 8 cm. long; ligules rounded.

40. *P. juncifolia*.

Plant 4-10 dm. high, leafy throughout; leaves longer.

Ligules ovate or rounded, acute or obtuse; leaves soft.

41. *P. confusa*.

Ligules very short, truncate; leaves rather firm.

42. *P. truncata*.

Flowering glumes more or less strigose on the lower portion, scabrous above.

Flowering glumes not longer than the empty glumes, ovate; pubescence much longer on the nerves.

43. *P. pratericola*.

Flowering glumes oblong, longer than the empty glumes; pubescence on the nerves scarcely stronger than that on the internerves.

Ligules ovate or rounded, obtuse or acutish.

41. *P. confusa*.

Ligules lanceolate, acuminate.

Plant yellowish green; leaves all filiform, soft and usually involute.

44. *P. lucida*.

Plant dark green, leaves broader, flat or conduplicate; at least those of the stem firm.

Creeping rootstock none; panicle dense; flowering glumes greenish at the base and purple above; leaves usually narrow and conduplicate.

45. *P. Buckleyana*.

Creeping rootstock often present; panicle narrow and usually lax; flowering glumes if at all purplish only slightly so at the very tip; leaves flat. 46. *P. Sheldonii*.

1. *Poa annua* L. In waste and cultivated places, from Lab. and B. C. to Ga. and Calif.; also in Mex. Naturalized from Europe.—Alt. up to 9000 ft.—Hamor's Lake, north of Durango.

2. *Poa Bigelovii* V. & S. From Tex. to Colo. and Calif.—Alt. up to 6000 ft.—"Colorado," locality not given; Colorado Springs; along Purgatoire River, near Trinidad.

3. *Poa pratensis* L. In meadows from Lab. and Alaska to Fla. and Calif.; also native of Europe and Asia.—Alt. 4000–11,500 ft.—Mountains northeast of Dolores; Fort Collins; Marshall Pass; Manitou; Villa Grove; Beaver Creek; Dead Lake; Crystal Park; mountains near Pagosa Peak; vicinity of Ouray; Cameron Cañon; Pagosa Springs; Happy Hollow; Cucharas Valley, near La Veta; Sangre de Cristo Creek; La Plata Cañon; Parrott City; Pass Creek; Cascade Cañon; Quimby; along Conejos River, north of Antonito.

4. *Poa cenisia* All. (*Poa flexuosa* Wahl.) In wet places in arctic or alpine regions from Greenl. to Alaska; also in Colo.—Alt. about 10,500 ft.—Mountains near Pagosa Peak.

5. *Poa arctica* R. Br. In wet places in arctic or alpine regions along the arctic coast and Alaska, the Canadian Rockies and Colo.—Alt. 11,000–14,000 ft.—Gray's Peak; Mt. Bartlett; Saddle, Pike's Peak; mountains near Pagosa Peak; Chambers' Lake.

6. *Poa callichroa* Rydb. On alpine peaks of Colo.—Alt. about 11,500 ft.—Dead Lake; Campton's Ranch.

7. *Poa pudica* Rydb. (*P. arctica* Scribn.; in part.) In wet places in alpine or subalpine Colo.—Alt. 11,000–13,000 ft.—High mountains about Empire; near Pagosa Peak; Stephen's Mine.

8. *Poa reflexa* V. & S. In wet meadows from Mont. and Ore. to N. M.—Alt. 8000–13,000 ft.—Twin Lakes; Seven Lakes; Silver Plume; high mountains about Empire; Cameron Pass; Marshall Pass; near Teller, North Park; Upper La Plata River; near Pagosa Peak; Democrat Mountain; headwaters of Sangre de Cristo Creek; Pass Creek; near Ironton, San Juan Co.; Chambers' Lake; Ute Pass road; Four-Mile Hill.

9. *Poa leptocoma* Bong. In wet meadows from Mont. and Alaska to Colo. and Calif.—Alt. 8500–12,500 ft.—Villa Grove; Pike's Peak Valley; chaparrel-covered hills southeast of Ouray; near Pagosa Peak; Columbine; Chicken Creek; Upper La Plata River; Ruby; Beaver Creek; Cameron Pass; Little Kate Mine, La Plata Mountains.

10. *Poa alpicola* Nash. (*Poa laxa* Thurb.) In wet places on the alpine peaks of Colo. and Utah; perhaps also Calif.—Alt. 11,500–13,000 ft.—Long's Peak; headwaters of Clear Creek and alpine ridges east of Middle Park; Bottomless Pit, near Pike's Peak; top of Mt. Hayden; Estes Park; Gray's Peak.

11. *Poa platyphylla* Nash & Rydb. (*Poa occidentalis* Vasey.) Along mountain streams of Colo. and N. M.—Alt. 7000–10,500 ft.—Near Pagosa Peak; Veta Pass; Cucharas River, near La Veta; Ojo; Wahatoya Cañon; headwaters of Sangre de Cristo Creek; Bob Creek, west of Mt. Hesperus;

Beaver Creek; Horsetooth Gulch; Howe's Gulch; Happy Hollow; Brantly Cañon; Rabbit-ears, Larimer Co.

12. *Poa compressa* L. In woodlands, among bushes and in cultivated places from N. H. and B. C. to N. C. and Calif.—Alt. up to 9500 ft.—Veta Pass, Costilla Co.

13. *Poa aperta* Scribn. In the mountains of Colo.—Telluride; about Ouray; Breckenridge.

14. *Poa macroclada* Rydb. Mountains of Colo.—Alt. about 9000 ft.—Rogers.

15. *Poa serotina* Ehr. In wet meadows and swamps from Newf. and B. C. to N. J. and Calif.; also in Europe.—Alt. 4000-9500 ft.—New Windsor, Weld Co.; plains and foot-hills, near Boulder; Mountain View; Fort Collins; gulch west of Soldier Cañon; along Poudre River.

16. *Poa interior* Rydb. (*Poa nemoralis* Am. auth.; in part.) In wet meadows from the Canadian Rockies and Wash. to N. Mex.—Alt. 5000-10,000 ft.—Fort Collins; Ute Pass; Twin Lakes; Estes Park; South Park; Marshall Pass; Beaver Creek; Stove Prairie Hill; hills about Box Cañon, west of Ouray; Cerro Summit; Andrew's Shetland ranch; La Plata Cañon; cañon west of Pennock's ranch, near Ft. Collins; Table Rock; foot of Mt. Richtofen, on Michigan River; Hotchkiss; mountains northeast of Dolores.

17. *Poa crocata* Mich. (*P. caesia strictior* A. Gray, and *P. nemoralis* Am. auth.; in part.) On hills and dryer meadows from Lab. and Alaska to Vt., Minn. and Ariz.—Alt. 5000-13,000 ft.—Fort Collins; Happy Hollow; near Narrows; Mount Baldy; Barnes' Camp; foot of Mt. Richtofen, North Park; South Park; Ruxton Creek; Robinson, Summit Co.; headwaters of Clear Creek and alpine ridges east of Middle Park; near Georgetown; in valley near Empire; mountains near Pagosa Peak; Gentian Ridge; West Spanish Peak; mountains between Sunshine and Ward; Graymont; Gunnison; Cameron's Cone; Crystal Park; Marshall Pass; Anita Peak; Willow Creek, Routt Co.

18. *Poa rupicola* Nash. (*Poa rupestris* Vasey.) On the mountains from Mont. and Ore. to Colo. and Utah.—Alt. 11,500-13,000 ft.—South Park; Gray's Peak; Silver Plume; Pike's Peak; Seven Lakes; near Pagosa Peak.

A form with more hairy glumes has been collected at the following localities: near Manitou; Little Kate Mine, La Plata Mountains; mountain near Veta Pass; mountain meadows, Pike's Peak; Cameron Pass, above timber line.

19. *Poa Pattersonii* Vasey. On the mountain peaks of Colo. and Ariz.—Alt. 10,000-13,000 ft.—South Park; headwaters of Clear Creek and alpine ridges east of Middle Park; summit of Mt. Garfield; West Spanish Peak; east of Cameron Pass, above timber line; mountains above Beaver Creek; Como Pass, above timber line.

20. *Poa Grayana* Vasey. On the mountains of Colo. and Wyo.—Alt. about 13,000 ft.—Pike's Peak; Peak Slope; Saddle; Devil's Causeway; Cameron Pass.

21. *Poa Lettermannii* Vasey. (*Poa Brandegei* Beal.) On the alpine peaks of Colo. and Wyo.—Alt. about 14,000 ft.—Gray's Peak.

22. *Poa alpina* L. In wet places on the mountain tops, along streams and

in the arctics, from Greenl. and Alaska to Que., Colo. and Utah.—Alt. 9000–13,000 ft.—Cameron Pass; near Pagosa Peak; Tennessee Pass; La Plata Cañon; Little Kate Mine, La Plata Mountains; mountains of Estes Park; South Park; Mt. Hesperus; Gray's Peak; Georgetown; Mt. Harvard; South Park; Mt. Richtofen; bank of Michigan, North Park.

23. *Poa phoenicea* Rydb. Mountains of Colo.—Alt. about 12,500 ft.—Vicinity of Pike's Peak: Peak Valley; Windy Point.

24. *Poa Wheeleri* Vasey. (*Poa cuspidata* Vasey.) In meadows from Mont. and Ida. to Colo. and Ore.—Alt. 6000–11,000 ft.—Berthoud's Pass; Marshall Pass; Ute Pass Road; North Park; Cameron Pass; Rist Cañon; Anita Peak; summit of North Park Range; Rabbit-Ear Range.

25. *Poa vaseyana* Scribn. In mountain meadows of Colo.—Alt. 9000–10,000 ft.—Silver Plume; Mt. Princeton; near Chambers' Lake.

26. *Poa tricholepis* Rydb. Mountain meadows of Colo.—Alt. 7500–11,500 ft.—Near Pagosa Peak; cañons and meadows, west of Ouray.

27. *Poa occidentalis* (Vasey) Rydb. (*Poa flexuosa occidentalis* Vasey.) In the mountains of Colo. and Utah.—Alt. 10,000–11,500 ft.—Twin Lakes; Beaver Creek.

28. *Poa pseudopratisensis* Scribn. & Rydb. In wet places from Neb. to S. D. and Colo.—Alt. 4500–6000 ft.—Colorado Springs; New Windsor, Weld Co.; along river below Fort Collins.

29. *Poa subpurpurea* Rydb. (*P. purpurascens* Vasey; not Sprengel.) In the mountains from Mont. and Wash. to Colo.—Cameron Pass.

30. *Poa epilix* Scribn. In the mountains from Mont. to Colo. and Utah.—Alt. 10,000–13,000 ft.—Buffalo Pass; Silver Plume; Camp Creek; high mountains, vicinity of Gray's Peak; Buena Vista; near Pagosa Peak; Cameron Pass; Little Kate Mine, La Plata Mountains; Poudre Cañon; Beaver Creek; summit of North Park Range.

31. *Poa nematophylla* Rydb. Dry hills of Colo.—Meeker, Rio Blanco Co.

32. *Poa longiligula* Scribn. & Williams. Hillsides and plains from S. D. and Ore. to N. M. and Calif.—Alt. 7000–10,000 ft.—Navajo Cañon; "Colorado Terr."; Glenwood Springs; Buena Vista; South Park; Sierra Sangre de Cristo; Black Cañon; Table Rock; Palisades; Horsetooth Gulch; bank of Grizzly Creek; North Park.

33. *Poa longipedunculata* Scribn. Hills and mountain-sides from Wyo. to N. Mex.—Alt. 5000–12,500 ft.—Mountains northeast of Dolores; hills about Trinidad; Rist Cañon; Silver Plume; Gray's Peak; Graymont; Stove Prairie; Lake Ranch; Bear Creek Divide; Beaver Creek; Marshall Pass; Manitou; Dolores; Veta Mountain; Poverty Ridge; near Pagosa Peak; Ojo; Crystal Park; Los Pinos; Grayback mining camps and Placer Gulch; Turkey Creek and tributaries; West Spanish Peak; West Mancos Cañon; West Indian Creek; plains near Denver; Black Cañon.

Poa longipedunculata virescens Williams. Chambers' Lake; hills about Trinidad.

34. *Poa scabriuscula* Williams. Dry mountains of Utah and Colo.—Alt. about 8500 ft.—South Park.

35. *Poa brevipaniculata* Scribn. & Williams. Dry meadows and mountain-sides in Colo.—Alt. 5500–10,000 ft.—Horsetooth Gulch; gulch west of Sol-

dier Cañon; Mt. Hesperus; Bob Creek; Cripple Creek; river-bluffs north of La Veta; Estes Park; Ojo; Veta Mountain; hills southeast of La Veta; Table Rock; Trinidad; headwaters of Pass Creek; Piney and Beaver Creeks; West Mancos River; Los Pinos; Van Boxle's ranch, above Cimarron; Seven Lakes; mountains near Veta Pass; Mt. Hesperus; West Indian Creek.

Poa brevipaniculata subpallida Williams is a low variety with pale-green color.—Rocky Mountains (*Hall & Harbour*); Bear Creek; headwaters of Clear Creek and alpine ridges, east of Middle Park; Stove Prairie Hill.

36. *Poa Fendleriana* (Steud.) Vasey. Dry hills and table lands from Colo. to N. Mex. and Calif.—Alt. 6000–11,500 ft.—Trinidad; Upper LaPlata; Manitou; Los Pinos; near Pagosa Peak; near Badito; Colorado Springs.

37. *Poa glaucifolia* S. & W. Moist banks from S. D. and Mont. to Colo.—Fort Collins and Calloway Hill.

38. *Poa Nevadensis* Scribn. In dry meadows and on hillsides from Mont. and B. C. to Colo., Nev. and Ore.—Alt. 5000–6500 ft.—Gulch west of Soldier Cañon; near Fort Collins; dry hills near Wood's ranch.

39. *Poa laevigata* Scribn. On dry meadows and hillsides from Mont. and Wash. to Colo.—Alt. 6500–9000 ft.—Gunnison; Chester; Iola; Mancos; along the Michigan, North Park; Rabbit-Ears, Larimer Co.

40. *Poa juncifolia* Scribn. Dry hills and plains of Wyo., Utah and Colo.—Middle Park; South Park; Georgetown; Hardin's ranch.

41. *Poa confusa* Rydb. Dry meadows and open "parks" in the mountains from Mont. and Nebr. to Colo.—Alt. 5000–10,000 ft.—Twin Lakes; dry plains, North Park; Colorado and Wyoming State line; near Ft. Collins.

A form with the glumes slightly strigose below.—Clear Lake; Georgetown.

42. *Poa truncata* Rydb. Meadows of Colo.—Alt. about 5000 ft.—Dillon, Summit Co.; Holdredge Ranch, North Park.

43. *Poa pratericola* Rydb. & Nash. (*P. andina* Nutt.) Dry plains and prairies of Nebr., Wyo. and Colo.—Alt. 4000–12,000 ft.—South Park; Green River; Twin Lakes; La Porte; mountains near Pagosa Peak.

44. *Poa lucida* Vasey. On dry hills from S. D. and Wyo. to Colo.—Alt. 5000–9000 ft.—Twin Lakes; Graymont; South Park; North Park; Columbine; vicinity of Ft. Collins; Crystal Creek; La Plata Cañon; Mancos; Holdredge Meadow, North Park; Beaver Creek Camp.

45. *Poa Buckleyana* Nash. On dry plains and hills from Nebr., Mont. and Wash. to Colo. and Utah.—Alt. 5000–12,000 ft.—Silver Plume; Buena Vista; Leroux Creek, Delta Co.; Cimarron; Encampment Meadows; meadow near Pinkhampton; Holdredge Meadow, North Park; Cameron Pass, above timber line; Marshall Pass; mountains above Beaver Creek.

46. *Poa Sheldonii* Vasey. On dry hills and mountain-sides in Colo.—Alt. 8000–12,000 ft.—Headwaters of Clear Creek and alpine ridges east of Middle Park; along Cottonwood Creek, near Buena Vista; Silver Plume; Mt. Ouray; Chicken Creek, west of Mt. Hesperus; West Mancos Cañon; Bob Creek; Como.

62. *PANICULARIA* Fabr. MANNA-GRASS, REED MEADOW-GRASS.

Spikelets ovate or oblong, 6 mm. or less long.

Flowering glumes slightly if at all scarious and entire at the apex.

Spikelets 3 mm. long or less; branches of the panicle drooping.

1. *P. nervata*.

Spikelets 4-6 mm. long; branches of the panicle ascending or spreading.

2. *P. americana*.

Flowering glumes with broad, dentate, scarious margins.

Spikelets 4-6-flowered.

3. *P. pauciflora*.

Spikelets 2-3-flowered.

4. *P. Holmii*.

Spikelets linear, 12 mm. or more long.

5. *P. borealis*.

1. *Panicularia nervata* (Willd.) Kuntze. (*Glyceria nervata* Trin.) In wet meadows and swamps from Lab. to B. C., Fla. and Calif.; also in Mex.—Alt. 4000-9000 ft.—Manitou; Crystal Park; mountains of Larimer Co.; Democrat Mountain; near Pagosa Peak; Pagosa Springs; Dome Rock Valley; Placer, Costilla Co.; Bosworth's ranch; Happy Hollow; Pagosa Springs.

2. *Panicularia americana* (Torr.) MacM. (*G. aquatica* Coult.; not Smith) In swamps and along streams from N. B. to Alaska, Tenn. and Nev.—Alt. 4000-8500 ft.—Mancos; mountains, Larimer Co.; Denver; Fort Collins; Pleasant Grove; New Windsor, Weld Co.; Saguache Creek; LaVeta; Baxter's ranch; cañon west of Palmers Lake; Table Rock; Bosworth's ranch, Stove Prairie; Pagosa Peak.

3. *Panicularia pauciflora* (Presl) Kuntze. (*G. pauciflora* Presl.) In wet meadows from Mont. to B. C., Colo. and Calif.—Alt. 9000-10,500 ft.—Bob Creek, west of Mt. Hesperus; near Pagosa Peak; Chester; near Chambers' Lake; east slope of Rabbit-Ear Range; mountains northeast of Dolores; Pagosa Peak.

4. *Panicularia Holmii* Beal. Dense thickets in Colo.—Alt. about 8500 ft.—Lamb's ranch, Long's Peak (Beal).

5. *Panicularia borealis* Nash. In shallow water from Me. to Alaska, N. Y., Colo. and Calif.—Alt. 5000-8500 ft.—Cerro Summit; Buffalo Pass Road, Routt Co.; Boulder.

63. *PUCCINELLIA* Parl. MEADOW-GRASS.

1. *Puccinellia airoides* (Nutt.) Wats. & Coult. (*Glyceria distans* Coult.; in part.) In wet meadows, especially in alkaline soil, from Man. to Mackenzie River, B. C., Kans. and Nev.—Alt. 4000-11,000 ft.—Buena Vista; Iola; Gunnison; Fort Collins; South Park; Durango; Alpine Tunnel; Saguache Creek; Doyle's; Georgetown; Colorado Springs; Walsenburg; Boulder; Longmont.

64. *FESTUCA* L. FESCUE-GRASS.

Empty glumes firm, the second 3-5-nerved.

Annuals or biennials; stamens 1-2.

Spikelets 7-12-flowered; awn not much exceeding the flowering glume in length, often much shorter.

1. *F. octoflora*.

Spikelets 1-7-flowered; awn much longer than the body of the flowering glume.

2. *F. microstachys*.

Perennials; stamens 3.

Leaves 4 mm. or more wide, flat; culm from a rootstock or with stolons.

Awns long, usually longer than the body of the flowering glumes; empty glumes narrowly lanceolate; branches of panicle reflexed or spreading.

3. *F. Jonesii*.

Awns, if any, very short; branches of the panicle ascending.

Glumes narrowly lanceolate, acuminate and awn-pointed; spikelets 3-4-flowered.

4. *F. fratercula*.

Glumes broadly lanceolate, abruptly acute; spikelets 5-9-flowered.

5. *F. elatior*.

Leaves (at least those of the sterile shoots) 2 mm. or less wide, strongly involute.

Culm from a rootstock or with stolons; sterile shoots mostly extra-vaginal.

Body of the flowering glume 5-6 mm. long; stem-leaves firm and often flat; spikelets 4-10-flowered.

6. *F. rubra*.

Body of the flowering glume 4 mm. long; leaves very narrow and soft; spikelets 2-3-flowered.

7. *F. Earlei*.

Culm densely tufted, no rootstock; sterile shoots mostly intra-vaginal.

Flowering glumes (without the awns) 3-4 mm. long, not twice as long as the first glume; plants 1-2 (rarely 3) dm. high; inflorescence spike-like.

Flowering glumes lanceolate, long-acuminate and long-awned; panicle dense; leaves short and firm.

8. *F. brachyphylla*.

Flowering glumes oblong-lanceolate, abruptly contracted into a short awn; panicle lax; leaves filiform and soft.

9. *F. minutiflora*.

Flowering glumes (without the awns) 5-8 mm. long, more than twice as long as the first glume.

Basal sheaths short; blades of stem-leaves rarely 8 cm. long.

Awns short, less than half as long as the glumes; inflorescence usually dense and its branches very short.

10. *F. pseudovina*.

Awns long, nearly equalling to much exceeding the body of the glumes in length; inflorescence open and branches more slender.

11. *F. ingrata*.

Basal sheath long and loose; blades of stem-leaves usually over 1 dm. long; inflorescence narrow and awn short.

12. *F. arizonica*.

Empty glumes thin, ovate-lanceolate, more or less scarious; second glume 1-nerved or 3-nerved only at the base; culms densely tufted with numerous basal sheaths.

Ligules long and acuminate; inflorescence open.

13. *F. Thurberi*.

Ligules short and rounded; inflorescence narrow and spikelike.

14. *F. confinis*.

1. *Festuca octoflora* Walt. (*F. tenella* Willd.) In dry, sandy soil from Que. to B. C., Fla. and Calif.—Alt. 4000-9000 ft.—Denver; New Windsor, Weld Co.; Veta Pass; Walsenburg; Denver; Wray; Quimby; Horsetooth Gulch; Palisades.

2. *Festuca microstachys* Nutt. In sandy soil from Ida. to B. C., Colo., Ariz. and Calif.—“Western Colorado.”

3. *Festuca Jonesii* Vasey. In woods from Mont. to B. C., Colo., Utah and Wash.—“Western Colorado.”

4. *Festuca fratercula* Rupr. On open hillsides, in cañons and meadows from Colo. to Arizona and Mex.—Alt. 7500-9500 ft.—Near Pagosa Peak; cañons and adjoining meadows, west of Ouray.

5. *Festuca elatior* L. In field, among bushes and in waste places from N. Sc. to Wash., N. C. and Calif. Cultivated and naturalized from Europe.—Alt. up to 5000 ft.—Fort Collins; Durango.

6. *Festuca rubra* L. In meadows from Lab. to Alaska, N. C. and Calif.; also in Europe and Asia.—Alt. up to 5000 ft.—Ft. Collins.

7. *Festuca Earlei* Rydb. In cañons of Colo.—Alt. about 9500 ft.—LaPlata Cañon.

8. *Festuca brachyphylla* Schultes. (*F. ovina brevifolia* S. Wats.) In arctic-alpine localities, in rather barren soil, from Greenl. to Alaska, Vt. and Calif.—Alt. 9500–14,500 ft.—Gray's Peak; Mt. Lincoln; Little Kate Mine, La Plata Mountains; Cumberland Mine; Cameron Pass; Pike's Peak; West Spanish Peak; near Pagosa Peak; Mt. Lincoln; Mt. McClellan; high mountains near Clear Creek; Beaver Creek; mountains northeast of Boreas; mountain above Barnes' Camp.

9. *Festuca minutiflora* Rydb. On alpine peaks in Colo. and Calif.—Alt. 10,000–12,000 ft.—Headwaters of Clear Creek; Manitou; Mt. Ouray; near Pagosa Peak; Como; Tennessee Pass; Mt. Lincoln; Cameron Pass; Mountains northeast of Boreas.

10. *Festuca pseudovina* Hackel. On dry hillsides and mountains from Sask. to B. C., Mich. and Colo.; also in Europe.—Alt. 9000–12,500 ft.—Bert-houd's Pass; Cameron Pass; Dead Lake; Mount Garfield; Beaver Creek; Poverty Flats; Palsgrove Cañon; Happy Hollow; near Teller, North Park; Chambers' Lake; Twin Lakes; mountains above Clear Creek; Veta Pass; Ute Pass road; Boreas; mountains northwest of Boreas.

11. *Festuca ingrata* (Hack.) Rydb. (*F. ovina* of western reports and *F. ovina ingrata* Hack.) On hillsides and in dryer meadows from Mont. to B. C., Colo. and Utah.—Alt. 3000–12,000 ft.—Grizzly Creek; Chicken Creek; Mount Garfield; Rabbit-Ear Pass; North Park; Wolcott, Eagle Co.; Barnes' Camp; along the Michigan, North Park; Beaver Creek; Como; near Monument; flats along Elk River; Campton's ranch; grass plot, Ft. Collins; Pinkham Creek, Larimer Co.; Willow Creek, Routt Co.

Festuca ingrata nudata (Vasey) Rydb. (*F. ovina nudata* Vasey) is a variety with narrower panicle, longer basal leaves, nearly naked stem and glabrous glumes.—Middle Park; North Park.

12. *Festuca arizonica* Vasey. (Including *F. Vaseyana* Hack.) On rocky slopes from Colo. to Utah, N. M. and Ariz.—Alt. 7000–10,000 ft.—Georgetown Pass; Twin Lakes; Pagosa Springs; West Mancos Cañon; foot-hills east of Mancos; Cottonwood Lake; Democrat Mountain; Idaho Springs; Veta Pass.

13. *Festuca Thurberi* Vasey. (*S. scabrella Vaseyana* Hack.) On hillsides in Colo. and southern Wyo.—Alt. 8000–12,000 ft.—Twin Lakes; Mt. Lincoln; Veta Pass; vicinity of Pike's Peak; Cimarron; Grizzly Creek; near Pagosa Peak; Front Range, Larimer Co.; foot-hills east of Mancos; West Mancos Cañon; Dark Cañon; Chicken Creek; Beaver Creek; North Park; Sangre de Cristo Creek; South Park; Argentine Pass; Happy Hollow; Hahn's Peak.

14. *Festuca confinis* Vasey. (*Poa Kingii* S. Wats.) In cañons and on hillsides from Mont. to Colo. and Calif.—Alt. 6500–10,000 ft.—Stove Prairie Hill and Stove Prairie, Larimer Co.; Boulder Cañon; Rist Cañon; Happy Hollow; Colorado and Wyoming State line; Beaver Creek.

65. *BROMUS* L. BROOM-GRASS, CHESS.

Flowering glumes compressed-keeled.

Palet less than $\frac{3}{4}$ as long as the flowering glume.

Leaves glabrous; glumes glabrous or merely scabrous. 1. *B. polyanthus*.

Leaves pubescent; glumes hairy at least when young. 2. *B. marginatus*.

Palet more than $\frac{3}{4}$ as long as the glume. 3. *B. unioloides*.

Flowering glumes rounded on the back, at least at the base.

Flowering glumes oval or broadly elliptic; second empty glume 5-7-nerved; first 3-nerved; introduced annuals.

Flowering glumes nearly as broad as long, awnless or with a short, dorsal awn. 4. *B. brizaeformis*.

Flowering glumes much longer than broad, always conspicuously awned.

Flowering glumes glabrous.

Sheaths glabrous; awn much shorter than the flowering glume, nearly erect. 5. *B. secalinus*.

Sheaths pubescent; awn fully as long as the glume, at maturity strongly divergent. 6. *B. patulus*.

Flowering glumes more or less hairy. 7. *B. hordeaceus*.

Flowering glumes lanceolate or oblong-lanceolate; second empty glume 3-nerved; first one 1-nerved except in *B. Porteri*.

Awns shorter than the glumes; perennials and all except *B. inermis* native.

Inflorescence more or less drooping.

First empty glume 3-nerved. 8. *B. Porteri*.

First empty glume 1-nerved.

Flowering glumes evenly pubescent on the back; sheaths densely lanate. 9. *B. lanatipes*.

Flowering glumes ciliate on the margins, glabrous or sparingly hairy on the back; sheaths glabrous or the lower sparingly hirsute.

10. *B. Richardsoni*.

Inflorescence not drooping.

Inflorescence narrow, its branches erect; flowering glumes usually awned. 11. *B. Pumpellianus*.

Inflorescence broad, its branches spreading; flowering glumes usually awnless. 12. *B. inermis*.

Awn longer than the glumes; introduced annuals.

Spikelets numerous on slender, recurved, secund pedicels; flowering glumes 8-12 mm. long. 13. *B. tectorum*.

Spikelets few; pedicels not secund; flowering glumes 12-16 mm. long. 14. *B. sterilis*.

1. *Bromus polyanthus* Scribn. In meadows from Mont. to Ore., N. M. and Calif.—Alt. 6000-11,500 ft.—Trimble Springs; hills above Dix P. O.; Cerro Summit; West Mancos Cañon; Rabbit-Ear Pass; Keblar Pass; Robinson, Summit Co.; Walsenburg; Veta Pass; foot of Mt. Richtofen, on the Michigan; near Chambers' Lake; Cameron Pass.

2. *Bromus marginatus* H. & A. In meadows from Alb. to B. C., Colo. and Calif.—Alt. 5000-6000 ft.—Steamboat Springs, Routt Co.; Ft. Collins; Fish Creek Falls, Routt Co.

Bromus marginatus latior Shear is a large variety with large open panicle and longer awns.—Vicinity of Boulder.

3. *Bromus unioloides* (Willd.) H. B. K. Meadows from Ala. and Calif. to La. and Tex.—Fort Collins; Cherokee Hill.

4. *Bromus brizaeformis* F. & M. Locally introduced from Mass. to Wash., Del. and Calif. Native of Europe and Asia.—Alt. 5000-6000 ft.—Vicinity of Boulder.

5. *Bromus secalinus* L. In waste places and fields from Me. to Wash., Fla. and Calif. Introduced from Europe and Asia.—Alt. about 5000 ft.—Boulder; Fort Collins.

6. *Bromus patulus* M. & K. In waste places from Mass. to Wyo., Mo. and Colo. Introduced from Europe.—Alt. about 5000 ft.—Fort Collins.

7. *Bromus hordeaceus* L. (*B. mollis* L.) In waste places from Me. to Wash., Del., Colo. and Ariz. Introduced from Europe.—Denver.

8. *Bromus Porteri* (Coul.) Nash. (*B. Kalmii Porteri* Coul.) On hillsides and in meadows from Man. to Sask., Alb., Colo. and Ariz.—Alt. 7000–11,000 ft.—About Ouray; West Mancos Cañon; Georgetown; Mancos; Cerro Summit; Arboles; Durango; North Park; Cameron Pass; Stove Prairie Hill; Twin Lakes; Buffalo Peaks; Gunnison; Marshall Pass; Robinson; Clear Creek; Middle Park; Wagon Wheel Gap; Chambers' Lake; Ft. Collins; Four-Mile Hill; Michigan Hill, Cameron Pass; Dolores.

9. *Bromus lanatipes* (Shear) Rydb. (*B. Porteri lanatipes* Shear.) On hillsides in Colo.—Alt. 5000–9000 ft.—Lower Boulder Cañon, Boulder Co.; Idaho Springs; Mountain View; Hiawatha; vicinity of Boulder; Lafayette; Empire Pass; Dome Rock Valley; Fort Collins; Poudre Cañon; Rist Cañon; quaking asp grove, west Gunnison Co.; gulch west of Soldier Cañon; Hahn's Peak, Routt Co.

10. *Bromus Richardsonii* Link. (*B. ciliatus* Coul.; not L.) In meadows and on hillsides from Sask. to B. C., Colo., Ariz. and Ore.—Alt. 6000–11,000 ft.—Cheyenne Mountain; vicinity of Pike's Peak; near Pagosa Peak; Pandora; Gunnison; mountains of Larimer Co.; Upper La Plata River; Beaver Creek; about Ouray; Mount Baldy; Ruxton Dell; Estes Park; Colorado Springs; Silver Plume; Marshall Pass; Tobe Miller's ranch; Moon's ranch; Happy Hollow; Four-Mile Hill; gulch west of Soldier Cañon; bank of Poudre; Andrew's ranch; western Gunnison Co.

11. *Bromus Pumpellianus* Scribn. In meadows and on hillsides from Sask. to Alaska and Colo.—Alt. 6000–10,000 ft.—On Grizzly Creek; Veta Pass; Gray's Peak; Walsenburg; Como; Beaver Creek Camp.

Bromus Pumpellianus melicoides Shear is an awnless variety.—Beaver Creek.

12. *Bromus inermis* Leyss. Escaped occasionally from cultivation from Ohio to Mont. and Colo.—Alt. about 5000 ft.—Fort Collins.

13. *Bromus tectorum* L. In waste places from Mass. to Wash., Va. and Utah. Introduced from Europe.—Alt. 5000–6000 ft.—Longmont, Boulder Co.; vicinity of Boulder; Fort Collins.

14. *Bromus sterilis* L. In waste places from Mass. and Ohio to Pa. and Colo. Introduced from Europe and Asia.—Alt. about 5000 ft.—Fort Collins; estray in garden plot.

Tribe 10. HORDEAE.

66. AGROPYRON. WHEAT-GRASS, QUACK-GRASS.

Rachis of the spike breaking up at maturity, the joints falling with the spikelet.

1. *A. Scribneri*.

Rachis of the spike continuous.

Cespitose, the innovations intra-vaginal; no horizontal stolons (except in *A. arizonicum*).

Spikelets compressed, remote on the axis; awns divergent.

Spikelets erect.

2 *A. Vaseyi*.

Spikelets spreading.

Empty glumes acute or obtuse; stem-leaves 3-4, not glaucous.

3. *A. spicatum*.

Empty glumes acuminate or awn-pointed; stem-leaves 6-7, glaucous.

4. *A. arizonicum*.

Spikelets subterete, approximate on the rachis or somewhat distant in *A. tenerum*.

Awn strongly divergent.

16. *A. Bakeri*.

Awn erect or none.

Awn long, usually longer than the body of the flowering glume.

Plant tall, over 3 dm. high, erect or ascending; empty glumes broadest below the middle; spike elongated.

Stem stout; spike 7-10 mm. wide, erect but usually unilateral; spikelets (excluding the awns) 12-15 mm. long.

5. *A. Richardsoni*.

Stem slender; spike about 5 mm. wide, usually nodding, seldom unilateral; spikelets (excluding the awns) about 1 cm. long.

6. *A. caninum*.

Plant 2-3 dm. high, densely tufted, decumbent at the base, geniculate; empty glumes broadest above the middle; spike short.

7. *A. andinum*.

Awn short or none.

Spike stout and dense, 3-8 cm. long, usually tinged with purple; empty glumes broadest above the middle.

8. *A. violaceum*.

Spike slender and lax, 7-20 cm. long, green; empty glumes broadest below the middle.

9. *A. tenerum*.

Stoloniferous, sometimes slightly tufted; innovations extra-vaginal; flowering glumes acute or merely awn-pointed.

Sheath not pubescent.

Flowering glumes glabrous or merely scabrous.

Spikelets erect, nearly cylindrical or slightly compressed.

Leafblades hairy above; empty glumes shorter than the spikelets, which are usually distant.

10. *A. lanceolatum*.

Leafblades scabrous but not hairy, spikelets usually not very lax.

Empty glumes nearly equalling the spikelets; spike elongated.

11. *A. pseudorepens*.

Empty glumes half as long as the spikelet; spike short.

12. *A. riparium*.

Spikelets spreading, much flattened.

13. *A. occidentale*.

Flowering glumes densely pubescent.

14. *A. molle*.

Sheaths pubescent; flowering glumes very scabrous or short-pubescent.

15. *A. Palmeri*.

1. *Agropyron Scribneri* Vasey. On high mountain-tops from Mont. to Colo. and Ariz.—Alt. 10,000-13,000 ft.—Silver Plume; Gray's Peak; near Pagosa Peak; Cumberland Mine, La Plata Mountains; Mt. Garfield; Bald Mountain; West Spanish Peak; Buena Vista; headwaters of Clear Creek; Cameron Pass; mountains above Beaver Creek.

2. *Agropyron Vaseyi* S. & S. On dry hills and mountain-sides from Mont. to Ore., Colo. and Utah.—Alt. 5000-6000 ft.—Vicinity of Boulder; Ute Pass; Golden; Horsetooth Gulch; gulch west of Soldier Cañon; foot-hills of Larimer Co.

3. *Agropyron spicatum* (Pursh) Rydb. (*A. divergens* Nees; *A. strigosum* Coult.) On dry hills and mountains from Mont. to Wash., Ariz. and Calif.—Alt. 5000-6500 ft.—Hot Sulphur Springs, Middle Park; along Platte River;

Bosworth ranch, Larimer Co.; Glenwood Springs, Garfield Co.; foot-hills, Larimer Co.; Poudre Cañon; Rist Cañon; Pinkham Creek, Larimer Co.

4. *Agropyron arizonicum* S. & S. In the mountains from Colo. to Ariz. and Mex.—Alt. 8000–11,000 ft.—Mountains between Sunshine and Ward, Boulder Co.; near Pagosa Peak; Robinson, Summit Co.

5. *Agropyron Richardsoni* (Trin.) Schrad. (*A. unilaterale* Cassidy.) In meadows and among bushes from Minn. and Sask. to B. C., Iowa and Colo.—Alt. 7000–10,000 ft.—Veta Pass; Manitou; Graymont; LaPlata Cañon; Crystal Park; mountains of Larimer Co.; Dillon; Salida, Chaffee Co.; Twin Lakes; Empire; along the Michigan, North Park; Como; Bosworth's ranch, Stove Prairie.

6. *Agropyron caninum* (L.) Beauv. In meadows from N. Sc. to Ida., N. C. and Colo.—Alt. about 7000 ft.—Mancos; North Park; Red Stone.

7. *Agropyron andinum* (S. & S.) Rydb. (*A. violaceum andinum* S. & S.) On high mountain-tops from Mont. to Colo.—Alt. about 9000 ft.—Silver Plume; summit of North Park Range.

8. *Agropyron violaceum* (Hornem.) Vasey. In the mountains from Greenl. to Alaska, N. H. and Utah.—Alt. 6500–12,000 ft.—Near Pagosa Peak; West Mancos Cañon; Cerro Summit; Crystal Park; Trinidad; near Badito; Green Mountain Falls; Gunnison; Buena Vista; Empire; Ft. Collins; gulch west of Soldier Cañon; La Porte; mountain west of Cameron Pass; Four-Mile Hill; North Park; near Chambers' Lake; Cameron Pass; Willow Creek and Fish Creek Falls, Routt Co.

9. *Agropyron tenerum* Vasey. On hillsides from Lab. to Alaska, N. H., Mo. and Colo.—Alt. 4000–7500 ft.—Fort Garland; New Windsor, Weld Co.; Colorado Springs; Arboles; Mancos; Fort Collins; Trimble Springs, north of Durango; Deer Run; Gunnison; Twin Lakes; Mancos; Soldier's Cañon.

10. *Agropyron lanceolatum* S. & S. On the plains from Wyo. to Wash. and Colo.—Alt. about 5000 ft.—Fort Collins; Calloway Hill; Horsetooth Gulch.

11. *Agropyron pseudorepens* S. & S. In meadows from Iowa to Alb., N. M. and Utah.—Alt. 4000–10,000 ft.—Clear Creek, near Empire; Kebler Pass; mountains near Pagosa Peak; vicinity of Boulder; Colorado Springs; La Porte; Beayer Creek; Durango; Grizzly Creek; New Windsor, Weld Co.; Pike's Peak; Fontaine qui Bouille Valley; Veta Pass; Ft. Collins; Graymont.

12. *Agropyron riparium* S. & S. On river banks from Mont. to Colo.—Alt. about 7000 ft.—Colorado Springs.

13. *Agropyron occidentale* Scribn. (*A. repens glaucum* Am. auth.) On prairies and plains from Man. and Sask. to Ore., Mo., N. M. and Ariz.—Alt. 4000–9500 ft.—Veta Pass; Weston's Pass; Trimble Springs, north of Durango; Longmont, Boulder Co.; Wahatoya Creek; Ft. Morgan; South Park; Hotchkiss; Table Rock; Ft. Collins; La Porte.

14. *Agropyron molle* (S. & S.) Rydb. In dryer valleys on the plains, especially in alkaline soil, from Sask. to Wash. and N. M.—Alt. 5000–9000 ft.—Weston's Pass; Arboles; New Windsor, Weld Co.; Mancos; Cerro Summit; Sangre de Cristo Creek; Wahatoya Creek; Golden; Cañon City, Fremont Co.; North Park; Hardin's ranch; Ft. Collins.

15. *Agropyron Palmeri* (S. & S.). (*A. spicatum Palmeri* S. & S.) In the mountains of Colo., N. M. and Ariz.—Alt. up to 7000 ft.—Mancos; Arboles; Quimby.

16. *Agropyron Bakeri* E. Nelson. Mountains of southern Colo.—Alt. 9000 ft.—Near Pagosa Peak.

67. HORDEUM L. BARLEY, SQUIRREL-TAIL.

Empty glumes all alike, subulate-filiform.

Empty glumes 3–6 cm. long; flowering glume of lateral spikelets long-awned.

1. *H. jubatum*.

Empty glumes 1–2 cm. long; flowering glume of lateral spikelets short-awned or awn-pointed.

Lateral spikelets flower-bearing.

2. *H. boreale*.

Lateral spikelets neutral.

3. *H. nodosum*.

Empty glumes of the middle spikelet lanceolate.

4. *H. pusillum*.

1. *Hordeum jubatum* L. On prairies and in meadows from Lab. to Alaska, N. J., Tex. and Calif.—Alt. 4000–11,000 ft.—Mancos; Cerro Summit; Arboles; vicinity of Boulder; Fort Collins; Fort Morgan; Golden; New Windsor; Alpine Tunnel; Ute Pass; Twin Lakes.

2. *Hordeum boreale* S. & S. In meadows from Mont. to Alaska, Colo. and Wash.—Alt. up to 10,000 ft.—Marshall Pass; South Park; Como; North Park.

3. *Hordeum nodosum* L. In meadows from Mont. to Alaska, Tex. and Calif.—Alt. 5000–9500 ft.—Georgetown; North Park; South Park; Durango; Golden; Twin Lakes; Ft. Collins; Chamber's Lake.

4. *Hordeum pusillum* Nutt. In arid valleys from Ill. to Ida., Ga. and Ariz.—Alt. 4000–6000 ft.—Foot-hills, Larimer Co.; New Windsor, Weld Co.; near the river, east of Ft. Collins; Buckhorn Creek, Larimer Co.

68. SITANION Raf.

Some of the empty glumes 2-cleft; lowest flower of one or both spikelets sterile and like the empty glumes, but inserted on a rachilla and falling away with it.

Sterile shoots numerous; stem slender; flowering glume 3-awned.

1. *S. Hystrix*.

Sterile shoots few; stem stout; flowering glume 1-awned.

2. *S. molle*.

Empty glumes all entire; lowest flower of both spikelets perfect.

Flowering glumes glabrous.

Stem-leaves very long, erect, flexuose, strongly involute.

3. *S. longifolium*.

Stem-leaves short, rigid, spreading or divaricate.

4. *S. brevifolium*.

Flowering glumes soft-pubescent.

5. *S. pubiflorum*.

1. *Sitanion Hystrix* (Nutt.) Smith. (*Ageliops Hystrix* Nutt.) On dry shale hills and among sage brush on the plains from Wyo. to Wash. and Colo.—Walsenburg; North Park.

2. *Sitanion molle* J. G. Smith. On moist mountain-sides in Colo.—Alt. 10,500 ft.—East side Buffalo Pass, Larimer Co.

3. *Sitanion longifolium* J. G. Smith. On hillsides and among rocks from Nebr. to Nev., Tex. and Ariz.—Alt. 6500–9000 ft.—Villa Grove, Saguache Co.; Denver; Mancos; North Park; mountains of Larimer Co.; Hardin's ranch; Oak Mesa, Delta Co.; Anita Peak, Routt Co.

4. *Sitanion brevifolium* J. G. Smith. On hills and mountain-sides from Wyo. to Utah, Colo. and Ariz.—Alt. 5000-10,000 ft.—Mancos; Ouray; Marshall Pass; vicinity of Boulder; mountains between Sunshine and Ward, Boulder Co.; Twin Lakes; Georgetown; Walsenburg; Colorado Springs; La Veta; vicinity of Ft. Collins; Willow Creek, Routt Co.

5. *Sitanion pubiflorum* J. G. Smith. On dry hills from Colo. to Ariz. and N. M.—Alt. about 6000 ft.—Trinidad.

69. *ELYMUS* L. WILD RYE, LYME-GRASS.

Flowering glumes long-awned; empty glumes lanceolate or linear-lanceolate, narrowed at the base.

Spike broad; spikelets spreading.

Flowering glumes hirsute or villose.

1. *E. canadensis*.

Flowering glumes scabrous or strigose-hispidulous or nearly glabrous.

Robust; spike usually included at the base; leaves 8-15 mm. wide.

2. *E. robustus*.

Slender; spike exserted; leaves seldom over 5 mm. wide.

3. *E. brachystachys*.

Spike narrow; spikelets erect.

Leaves 7-15 mm. wide, spreading; empty glumes lanceolate, acuminate to short-awned.

4. *E. glaucus*.

Leaves less than 5 mm. wide, usually nearly erect; empty glumes very narrowly linear-lanceolate, long-awned.

Spike 7-8 mm. thick; awns 30-40 mm. long.

5. *E. Saundersii*.

Spike 5 mm. thick or less; awns 5-10 mm. long.

6. *E. Macounii*.

Flowering glumes awnless or short-awned; empty glumes linear-aristiform or subulate, or if broader not narrowed at the base.

Empty glumes aristiform or narrowly subulate.

Plant stout, 1-2 m. high; spikelets 2-6 at each joint; flowering glumes acute or very short-awned; in our form scabrous-stigulose.

7. *E. condensatus*.

Plant slender, 3-10 dm. high; spikelets 1-2 at each joint.

Flowering glumes broadly lanceolate, acute or minutely awn-pointed, glabrous; rachis scabrous on the sharp angle; spikelets erect.

8. *E. triticoides*.

Flowering glumes narrowly lanceolate, awned; rachis nearly terete, strigose; spikelets somewhat spreading.

Flowering glumes glabrous.

9. *E. ambiguus*.

Flowering glumes strigose.

10. *E. strigosus*.

Flowering glumes villous.

12. *E. villiflorus*.

Empty glumes lanceolate-subulate, tapering from a rather broad base; spikelets usually singly; flowering glumes glabrous.

11. *E. simplex*.

1. *Elymus canadensis* L. On river-banks and among bushes from N. S. and Wash. to Ga. and N. M.—Alt. 4000-7000 ft.—Durango; Fort Collins; along Platte River, near Denver; La Porte, Larimer Co.; Salida, Chaffee Co.; gulch west of Soldier Cañon; Black's Lake.

2. *Elymus robustus* S. & S. On river-banks from S. D. to Ida., Mo. and Colo.—Alt. 5000-6000 ft.—Idaho Springs; Black Cañon; vicinity of Boulder; Fontaine qui Bouille.

3. *Elymus brachystachys* Scribn. & Ball. On dry plains and hills from Mich. and S. D. to Tex., N. M. and Utah; also in Mex.—Alt. 4000-6500 ft.—Rist Cañon, Larimer Co.; eastern Colorado; along river, east of Ft. Collins.

4. *Elymus glaucus* Buckley. (*Elymus Sibiricus* Thurb.; not L.) In mead-

ows and among bushes from Mich. to Alb., B. C., Colo. and Calif.—Alt. 7000–11,000 ft.—Mountains near Pagosa Peak; Hamor's Lake, north of Durango; about Ouray; Keblar Pass; Villa Grove; Horsetooth Gulch; Ute Pass road; mountains above Cameron Pass; edge of aspen grove, western Gunnison Co.

5. *Elymus Saundersii* Vasey. On mountains in Colorado.—Exact locality not given.

6. *Elymus Macounii* Vasey. In meadows from Man. and Sask. to Alb., N. Mex. and Utah.—Alt. 4000–7000 ft.—Denver; Durango; Fort Collins; Gunnison; Manitou.

7. *Elymus condensatus* Presl. On hills and in dryer valleys from Alb. and B. C. to N. M. and Calif.—Alt. 5000–10,000 ft.—Grand River at Hot Sulphur Springs; Doyle's; vicinity of Boulder; Chester, Saguache Co.; Grant Creek; Deadman Cañon; Campton's ranch; Miller's ranch, near La Porte.

8. *Elymus triticoides* Nutt. In meadows and on hillsides from Mont. to Wash., Colo. and Calif.—Alt. 6000–9000 ft.—Grant Creek; foot-hills, Larimer Co.; Georgetown; Barnes' ranch, Larimer Co.; Rist Cañon.

9. *Elymus ambiguus* Vasey & Scribn. In cañons and on hillsides in Colo.—Alt. 6000–9000 ft.—Penn Gulch; Empire; Fort Garland; Minnehaha; near Manitou; Engelmann Cañon; Rist Cañon, Larimer Co.; near Badito; Artists' Glen; North Cheyenne Cañon; Veta Pass; Campton's ranch.

10. *Elymus strigosus* Rydb. In the foot-hills and on shale slopes in Colo. and Wyo.—Alt. about 7700 ft.—Near Boulder.

11. *Elymus simplex* S. & W. Dry plains and hills from Wyo. and Colo. to Ore.—Alt. up to 11,000 ft.—Robinson, Summit Co.

12. *Elymus villiflorus* Rydb. On plains and foot-hills of Colo. Apparently the same also in the Black Hills and the Canadian Rockies—Alt. 5000–6000 ft.—Vicinity of Boulder.

LOLIUM L. RYE-GRASS.

1. *Lolium perenne* L. In waste places and cultivated ground from N. S. to Va., Calif. and Wash.—Ft. Collins.

Family 19. CYPERACEAE. SEDGE FAMILY.

Flowers of the spikelets perfect or at least one perfect.

Glumes of the spikelets 2-ranked.

Perianth present, the members bristle-like; inflorescence axillary.

1. DULICHIMUM.

Perianth wanting; inflorescence in terminal, solitary or umbelled heads.

2. CYPERUS.

Glumes of the spikelets spirally imbricated.

Base of the style not at all or only slightly thickened, deciduous.

Perianth-bristles conspicuously elongated.

3. ERIOPHORUM.

Perianth-bristles not conspicuously elongated.

4. SCIRPUS.

Base of the styles manifestly swollen, persistent as a tubercle on the achenes.

Perianth present; spike solitary.

5. ELEOCHARIS.

Perianth wanting; spikelets umbellate.

6. FIMBRISTYLIS.

Flowers monoecious or dioecious.

Achenes not enclosed in a perigynium; glumes 2-flowered.

7. ELYNA.

Achenes enclosed in a perigynium; glumes 1-flowered.

8. CAREX.

1. *DULICHIMUM* L. C. Richard.

1. *Dulichium arundinaceum* (L.) Britt. In wet and muddy places from N. S. to B. C., Fla. and Tex.—Locality not given.

2. *CYPERUS* L. *CYPERUS*, *GALINGALE*, *NUT-GRASS*, *PAPYRUS*.

Rachis persistent.

Annuals.

Glumes awned or mucronate.

Glumes acute, neither awned nor mucronate.

Perennials.

Glumes tipped with a curved or bent awn.

Glumes blunt or merely mucronate.

Rachis deciduous above the two empty glumes.

1. *C. inflexus*.

2. *C. acuminatus*.

3. *C. Fendlerianus*.

4. *C. Bushii*.

5. *C. filiculmis*.

1. *Cyperus inflexus* Muhl. In wet, sandy soil from Vt. to B. C., Fla. and Calif.; also in Mex.—Alt. 5000-6500 ft.—Plains and foot-hills near Boulder; Ft. Collins; along Platte River, near Denver; Cañon City; New Windsor, Weld Co.; Arkansas River; along Poudre River.

2. *Cyperus acuminatus* Torr. & Hook. In wet soil from Ill. to Ore., La. and Calif.—Exact locality not given.

3. *Cyperus Fendlerianus* Boeckl. In wet soil from Tex. to Colo., Ariz. and Mex.—Alt. 4000-6000 ft.—Colorado Springs; Arkansas Cañon.

4. *Cyperus Bushii* Britt. (*C. Schweinitzii* Coult.; not Torr.) In sandy soil from Wisc. to Ore., Kans. and Colo.—Alt. 4000-5000 ft.—Denver; Meadow Park.

5. *Cyperus filiculmis* Vahl. In dry fields and on hills from N. H. to Minn., Fla. and Tex.—Alt. about 5500 ft.—Colorado Springs.

3. *ERIOPHORUM* L. *COTTON-GRASS*.

Achenes obovoid, obtuse.

Glumes ovate-lanceolate; achenes light brown.

Glumes oval or ovate, obtuse; achenes dark brown, almost black.

Achenes linear-oblong, acute.

1. *E. polystachyon*.

2. *E. ocreatum*.

3. *E. gracile*.

1. *Eriophorum polystachyon* L. In bogs from Greenl. to Alaska, Ga. and Colo.—Alt. 4000-11,500 ft.—Hamor's Lake, north of Durango; Seven Lakes; West Cliff; Estes Park, Larimer Co.

2. *Eriophorum ocreatum* A. Nels. In bogs of Wyo. and Colo.—Twin Lakes.

3. *Eriophorum gracile* Koch. In bogs from Newf. to Alaska, Pa. and Calif.—Estes Park, Larimer Co.

4. *SCIRPUS* L. *BULL-RUSH*, *CLUB-RUSH*.

Involucre of a single bract or wanting.

Spikelets solitary, rarely 2 together; plants dwarfed.

Annuals; bristles none.

Perennials; bristles present.

Involucre none.

Involucre of one erect bract.

1. *S. coloradensis*.

2. *S. pauciflorus*.

- Bristles present, longer than the achenes. 3. *S. caespitosus*.
 Bristles wanting. 4. *S. pumilis*.
 Spikelets normally more than one, usually several or many; taller plants.
 Spikelets few, 1-12, appearing lateral.
 Annual with fibrous roots. 5. *S. Hallii*.
 Perennial with rootstocks. 6. *S. americanus*.
 Spikelets numerous, umbellate. 7. *S. lacustris*.
 Involucre of 2 or more leaves with flat blades.
 Spikelets few, umbelled or capitate, relatively large. 8. *S. campestris*.
 Spikelets numerous, in compound umbels or in umbelled heads, relatively small.
 Style-branches 2; achenes plano-convex; bristles mostly 4.
 9. *S. rubrotinctus*.
 Style-branches 3; achenes 3-angular; bristles 6. 10. *S. atrovirens*.
1. *Scirpus coloradensis* Britt. On muddy shores of lakes in northern Colo.—Alt. about 5000 ft.—Larimer Co.
 2. *Scirpus pauciflorus* Lightf. In wet soil from Anticosti to B. C., N. Y. and Calif.—Alt. 9500-11,500 ft.—Antonito; Seven Lakes; Ruxton Dell; Georgetown.
 3. *Scirpus caespitosus* L. In bogs and among wet rocks from Greenl. to Alaska, N. C. and Colo.; also Europe and Asia.—Lat. 39°-41°.*
 4. *Scirpus pumilus* Vahl. In wet places in alpine regions in Alb. and Colo.—“Rocky Mountains.”
 5. *Scirpus Hallii* A. Gray. In wet soil from Mass. to Colo., Fla. and Tex.; also Mex.—Locality not given.
 6. *Scirpus americanus* Pers. (*S. pungens* Vahl.) In fresh and alkaline swamps from Me. to B. C., Fla. and Calif.—Alt. 4000-6500 ft.—Plains and foot-hills near Boulder; Julesburg; mesas near Pueblo; Colorado Springs; Lake City; Spring Cañon; Platte River, Denver; Fort Collins.
 7. *Scirpus lacustris* L. In lakes and swamps from Newf. to B. C., Fla. and Calif.—Alt. 4000-8500 ft.—Gypsum, Eagle Co.; Walsenburg; Ft. Collins; Grand Junction; Buffalo Pass, Park Range; New Windsor, Weld Co.; near Ft. Collins.
 8. *Scirpus campestris* Britton. (*S. maritimus* of Coult. Man.) In wet places, especially with alkaline soil, from Man. to Wash., Tex. and Ariz.; also Mex.—Alt. 4000-6500 ft.—Ft. Collins; New Windsor, Weld Co.; Montrose; Walsenburg; Grand Junction; lowland along Poudre River; Ft. Collins.
 9. *Scirpus rubrotinctus* Fernald. In swamps from Newf. to Ida., N. Y. and Colo.—Alt. 4000-8000 ft.—McCoy; La Veta; Steamboat Springs, Routt Co.
 10. *Scirpus atrovirens* Muhl. In swamps from N. Sc. to Sask., Ga. and La. and Colo. West of Man. and Nebr. it is only represented by *v. pallidus* Britt.—Alt. 4000-6000 ft.—Plains and foot-hills near Boulder; Ft. Collins; New Windsor, Weld Co.; along Poudre River, Ft. Collins.

5. **ELEOCHARIS** R. Br. SPIKE-RUSH.

- Style-branches 2.
 Annuals with fibrous roots. 1. *E. atropurpurea*.
 Perennials with horizontal rootstock.
 Culm stout; tubercle conic-triangular. 2. *E. palustris*.
 Culm slender; tubercle narrower. 3. *E. glaucescens*.

* Hall & Harbour, who collected in Colorado, did not give any definite localities. On the labels is only given: Rocky Mts., lat. 39°-41°.

Style-branches 3.

Achenes cancellate and longitudinally ribbed; spikelet flat.

4. *E. acicularis*.

Achenes smooth, papillose or reticulate; spikelet terete.

5. *E. acuminata*.

Achenes papillose.

Achenes finely reticulate.

6. *E. arenicola*.

Spikelets ovoid, blunt.

7. *E. montana*.

Spikelets narrowly oblong, acute.

1. *Eleocharis atropurpurea* (Retz.) Kunth. In wet soil from Iowa to Colo., Fla. and N. Mex.; also Mex. and Trop. Am.—Reported from Colorado, but doubtful.

2. *Eleocharis palustris* (L.) R. & S. In swamps from Lab. and Alaska to Va. and Calif.; also in Europe and Asia.—Alt. 4000–10,000 ft.—Trimble Springs, near Durango; Gunnison; Ruxton Dell; Sterling, Logan Co.; New Windsor, Weld Co.; Ft. Collins; along Platte River, near Denver.

3. *Eleocharis glaucescens* (Willd.) Schultes. In swamps and wet meadows from Me. to Mont., Fla. and Ariz.—Alt. 4000–7000 ft.—Cucharas River, below La Veta; Julesburg; mesas near Pueblo; Quimby.

4. *Eleocharis acicularis* (L.) R. & S. In wet soil and mud from Newf. to Sask., Wash., Fla. and Calif.; also Mex., Cent. Am., Europe and Asia.—Alt. 4000–10,000 ft.—Divide between Colorado Springs and Denver; New Windsor, Weld Co.; Georgetown; river bank, Ft. Collins.

5. *Eleocharis acuminata* (Muhl.) Nees. In wet soil from N. Sc. to Alb., Ga., La. and Colo.—Mt. Lincoln.

6. *Eleocharis arenicola* Torr. On sandy shores and in swamps from S. C. to Colo., Fla. and Tex.—Salida.

7. *Eleocharis montana* (H. B. K.) R. & S. In wet places from Colo. to Calif. and Mex.—Alt. about 7000 ft.—Dolores.

6. *FIMBRISTYLIS* Vahl.

Leaves strongly involute.

1. *F. castanea*.

Leaves flat.

2. *F. thermalis*.

1. *Fimbristylis castanea* (Michx.) Vahl. In saline soil from N. Y. to Neb., Fla. and Tex.—Lat. 39°–41°.

2. *Fimbristylis thermalis* S. Wats. Usually near warm springs from Colo. to Calif.—Sterling, Logan Co.

7. *ELYNA* Schrad.

1. *Elyna Bellardi* (All.) Koch. (*Kobresia scirpina* Willd.) In wet places in alpine or arctic regions from Greenl. to Alaska and Alb.; also in Colo.—Alt. 8500–13,000 ft.—South Park; Twin Lakes; Georgetown; Clear Creek, near Georgetown; summit of Mt. Garfield; Ruxton Dell; Sierra Blanca.

8. *CAREX* L. SEDGE.

Stigmata 2; spikes all or nearly all bisexual, or dioecious, sessile.

VIGNEAE.

Stigmata 3; or if 2, the spikes mostly unisexual, the lateral ones pistillate (species of *Microrhyncha*, *C. pulla* and *C. misandra*).

CARICES GENUINAE.

VIGNEAE.

- I. Spike single, androgynous* or unisexual.
 Perigynia erect, with the hyaline beak split on the convex face.
 2. *NEUROCHLAENAE*.
 Perigynia spreading at maturity, spongy at the base with a serrate bidentate beak.
 5. *C. gynocrates*.
- II. Spikes several.
 A. Beak of the perigynium entire, truncate or oblique.
 Spikes remote; perigynia erect, several-nerved; scales hyaline.
 Spikes green; perigynia not winged. 1. *BRACHYSTACHYAE*.
 Spikes brown; perigynia winged. 21. *C. siccata*.
 Spikes sessile in a rounded or ovoid head.
 Perigynia erect, prominently many-nerved. 10. *CEPHALOSTACHYAE*.
 Perigynia spreading, nerveless or nearly so. 11. *SPHAEROSTACHYAE*.
- B. Beak of perigynium bidentate or in the last split on one side.
 1. Spikes androgynous or dioecious.
 Perigynia elliptic and acuminate to orbicular, faintly nerved or nerveless, slightly spreading, spongy at the base, from green to brownish.
 5. *ACANTHOPHORAE*.
 Perigynia ovate or lanceolate, nerved.
 Spikes in a dense-flowered spicate inflorescence; bracts often conspicuous; perigynia not spongy at the base, winged.
 6. *XEROCHLAENAE*.
 Spikes in an interrupted spicate inflorescence; bracts inconspicuous; perigynia spongy at the base. 7. *PHAENOCARPAE*.
2. Spikes gynaeceandrous.†
 Perigynia wingless.
 Spikes silvery to light green, remote; perigynia membranous, light green, erect.
 3. *ARGYRANTHAE*.
 Spikes brownish.
 Perigynia spreading, spongy at the base; spikes in a spicate inflorescence. 4. *ASTROSTACHYAE*.
 Perigynia erect; spikes in an oval or rounded head. 23. *C. Bonplandii*.
 Perigynia winged.
 Perigynia lanceolate to ovate, narrowly winged; scales brownish. 8. *ATHROSTACHYAE*.
 Perigynia ovate to nearly orbicular, broadly winged; scales green to light brown. 9. *PTEROCARPAE*.

CARICES GENUINAE.

- I. Perigynia neither inflated nor tapering into a long beak.
 A. Spike solitary.
 Perigynia glabrous; beak not ciliate.
 Perigynia erect or in *C. obtusata* horizontally bent.
 Perigynia greenish. 16. *LEIOCHLAENAE*.
 Perigynia brown.
 Achenes terete. 19. *LAMPROCHLAENAE*.
 Achenes triquetrous. 34. *C. Parryana*.
 Perigynia reflexed. 17. *ATHROCHLAENAE*.
 Perigynia pubescent or at least the beak ciliate.
 Perigynia membranous; scales very broad and scarious-margined; bracts not foliaceous. 20. *ELYNANTHAE*.
 Perigynia not membranous; scales narrow, acuminate; bracts more or less foliaceous. 58. *C. scirpoidea* and 59. *C. oreocharis*.
- B. Spikes several.

*Staminate above, pistillate below.

†Pistillate above, staminate below.

1. *Perigynia* compressed; scales very dark.
 Spikes all gynaeceandrous or the lateral pistillate; stigmata 3 (except sometimes in *C. misandra*).
 Spikes all gynaeceandrous. 12. MELANANTHAE.
 Lateral spikes pistillate.
 Spikes sessile or nearly so. 12. MELANANTHAE.
 Spikes long-peduncled. 18. STENOCARPAE.
 Terminal spike staminate, the lateral pistillate or the uppermost of these staminate or androgynous.
 Stigmata 3; spikes oblong. 35. *C. Raynoldsii*.
 Stigmata 2; spikes cylindrical. 13. MICRORHYNCHAE.
2. *Perigynia* turgid.
 Spikes 2-4, all gynaeceandrous, dark brown; perigynia gibbous, papillose. 14. AEORASTACHYAE.
 Spikes several; the terminal and sometimes the uppermost of the lateral ones staminate; the rest pistillate or in *C. Backii* all androgynous.
 Perigynia glabrous; spikes peduncled.
 Beak short or none; spikes erect, loosely flowered; perigynia nerved. 15. CENCHROCARPAE.
 Beak prominent, bifid or bidentate.
 Spikes not very densely flowered, drooping; perigynia faintly nerved, erect or slightly spreading. 23. HYMENOCHLAENAE.
 Spikes densely flowered, erect; perigynia nerved, squarose at maturity. 24. SPIROSTACHYAE.
- Perigynia* pubescent.
 Pistillate spikes few-flowered, roundish; perigynia obovate to globose, obscurely nerved; bracts foliaceous but sheathless. 21. SPHAERIDIOPHORAE.
 Pistillate spikes cylindric, dense-flowered; perigynia ovate or ovate-lanceolate, nerved; bracts sheathing. 22. TRICHOCARPAE.
- II. *Perigynia* inflated and tapering into a long beak.
 Perigynia abruptly contracted into a very long, slender beak. 66. *C. longirostris*.
 Perigynia gradually tapering into the beak.
 Perigynia, at least the lower, reflexed at maturity, sessile; bracts sheathing. 25. ECHINOSTACHYAE.
- Perigynia* not reflexed.
 Bracts sheathless; perigynia sessile. 26. PHYSOCARPAE.
 Bracts sheathing; perigynia stipitate. 27. RHYNCHOPHORAE.

I. **VIGNEAE.** Stigmata 2. Spikes all or nearly all bisexual or dioecious, sessile.

I. **BRACHYSTACHYAE.**

Spikes several, short and few-flowered, sessile, remote, light-green; scales hyaline; perigynium erect, several-nerved, spongy at the base.

Spikes gynaeceandrous (i. e., pistillate above, staminate below); bracts inconspicuous; perigynium light-green, ovate, tapering into a short, almost entire beak.

1. *C. canescens*.

Spikes androgynous (i. e., staminate above, pistillate below); bracts narrow, but conspicuous; perigynium shining reddish-brown, abruptly-beaked.

2. *C. tenella*.

2. **NEUROCHLAENAE.**

Spike single, androgynous, shining reddish-brown; perigynium erect, oblong, faintly nerved, scabrous along the short hyaline beak, with the orifice slit on the convex face.

One species.

3. *C. nardina*.

3. ARGYRANTHAE.

Spikes several, short and loose-flowered, sessile, remote, silvery to light-green, gynaeandrous; bracts short; scales hyaline; perigynium erect, membranaceous, light-green, stipitate, lanceolate, nerved, serrate along the margins, tapering into a long bidentate beak.

One species.

4. *C. Deweyana*.

4. ASTROSTACHYAE.

Spike single or several, short and few-flowered, sessile, remote; bracts short and narrow; scales brownish; perigynium sessile, spreading at maturity, cordate to ovate, several-nerved, spongy at base, tapering into a serrate, bidentate beak.

Spike single, unisexual or androgynous.

5. *C. gynocrates*.

Spike several, gynaeandrous.

Perigynium narrowly ovate, faintly nerved.

6. *C. stellulata*.

Perigynium broadly ovate, prominently nerved.

7. *C. sterilis*.

5. ACANTHOPHORAE.

Spikes several, short, but dense-flowered, sessile, androgynous; bracts often long; scales greenish to brown; perigynium slightly spreading, elliptical and acuminate to suborbicular, faintly nerved or nerveless, spongy at base, narrowly winged, the beak serrulate, bidentate.

Spikes green, forming a dense, decompound panicle.

8. *C. vulpinoidea*.

Spikes forming a spike or head.

Inflorescence spicate.

Spike interrupted.

Spike contiguous.

Inflorescence capitate.

9. *C. Hookeriana*.

10. *C. occidentalis*.

11. *C. Hoodii*.

6. XEROCHLAENAE.

Spikes many, small, in a dense-flowered spicate inflorescence, sessile, contiguous, androgynous or dioecious; bracts often conspicuous; scales brownish; perigynium stipitate, erect, ovate to lanceolate, nerved, brown, winged, serrulate along the margins, tapering into a distinct, bidentate beak.

Scales acuminate.

Perigynium ovate, acuminate; spikes often unisexual.

12. *C. marcida*.

Perigynium lanceolate; spikes bisexual.

13. *C. Sartwellii*.

Scales awned, perigynium ovate-lanceolate; spikes mostly unisexual.

14. *C. Douglasii*.

7. PHAENOCARPAE.

Spikes small, many in an interrupted spicate inflorescence, sometimes paniculately branched, sessile, contiguous or nearly so, androgynous; bracts inconspicuous; scales brownish; perigynium somewhat spreading, ovate, nerved, shining brown, spongy at base, the beak serrulate, bidentate.

One species.

15. *C. teretiuscula*.

8. ATHROSTACHYAE.

Spikes several, but not many, in a dense-flowered spike or head, sessile, gynaeandrous; bracts seldom conspicuous; scales brownish; perigynium

erect, lanceolate to ovate, more or less winged, very seldom wingless, tapering into a long serrulate or ciliate beak, with the orifice oblique or bidentate.

Perigynium winged.

Spikes in an oval or roundish head; perigynium ovate to lanceolate; beak slit on the convex side.

Bracts longer than the inflorescence.

17. *C. athrostachya*.

Bracts inconspicuous.

Perigynium broadly ovate to suborbicular, rather light brown or greenish.

18. *C. festiva*.

Perigynium lanceolate, very dark brown and shining.

18a. *C. ebenea*.

Spikes in a more or less distinct spike.

Perigynium lanceolate, narrowly winged, ciliate; inflorescence short.

16. *C. scoparia*.

Perigynium ovate.

Beak bidentate.

Perigynium thin, green; spikes nodding when young, tapering at the base.

20. *C. pratensis*.

Perigynium firm, brown; spikes erect, strict.

22. *C. Liddonii*.

Beak not bidentate.

Beak slit on the convex side.

19. *C. petasata*.

Beak oblique at the orifice.

21. *C. siccata*.

Perigynium not winged.

23. *C. Bonplandii*.

9. PTEROCARPAE.

Spikes several, large and heavy, dense-flowered, contiguous or the lower ones remote, sessile, gynaeandrous; bracts inconspicuous; scales light-brown to green; perigynium erect, ovate to almost orbicular, much compressed, nerved, broadly winged, prominently serrulate, the beak bidentate.

Spikes ovate in a roundish head.

25. *C. stramineiformis*.

Spikes in a spicate inflorescence.

Perigynium about 5-nerved.

24. *C. straminea*.

Perigynium 7-15-nerved.

26. *C. festucacea*.

10. CEPHALOSTACHYAE.

Spikes several, reddish brown, androgynous, dense-flowered, sessile in a roundish or ovoid head; bracts inconspicuous; scales ovate, acute; perigynium stipitate, erect, ovate, turgid, spongy, prominently many-nerved, shining reddish-brown, the beak scabrous, obliquely cut, with hyaline orifice.

One species.

27. *C. stenophylla*.

11. SPHAEROSTACHYAE.

Spikes several, androgynous, dense-flowered, sessile in a roundish head; bracts inconspicuous; scales broadly ovate with hyaline margins; perigynium spreading at maturity, stipitate, ovate, turgid, nerveless or nearly so, yellowish, becoming fuscous at maturity, scabrous along the prominent, obliquely cut beak.

One species.

28. *C. incurva*.

II. CARICES GENUINAE. Stigmata 2 or 3. Spikes mostly unisexual.

12. MELANANTHAE.

Spikes several, dense-flowered, mostly peduncled and drooping, contiguous, gynaeandrous or the terminal staminate, the lateral pistillate; bracts conspicuous, but narrow, sheathless; scales dark-colored; perigynium sessile, erect, very seldom spreading, sessile, more or less compressed, elliptical, few-nerved, granulated and often scabrous along the upper margins, purplish-spotted to almost black, the beak short, entire to emarginate; stigmata 3.

Spikes several.

Terminal spike gynaeandrous or in *C. Parryana* sometimes pistillate.

All spikes gynaeandrous peduncled and often somewhat drooping.

Spikes ovate.

Scales and perigynia blackish.

31. *C. atrata*.

Scales and perigynia copper-colored.

32. *C. chalciolepis*.

Spikes cylindric; scales blackish; perigynia light-green.

33. *C. bella*.

Lateral spikes pistillate, sessile, erect.

Spikes contiguous in a dense head.

Perigynia erect.

29. *C. alpina*.

Perigynia spreading.

30. *C. melanocephala*.

Spikes somewhat remote, spicate.

Perigynia subtriquetrous; lateral spikes usually small or none; scales purplish, with hyaline margins.

34. *C. Parryana*.

Perigynia compressed; lateral spikes not reduced;

35. *C. Raynoldsii*.

36. *C. Buxbaumii*.

Terminal spike staminate, the lateral pistillate and peduncled, but erect and contiguous.

35. *C. Raynoldsii*.

Spike single.

34. *C. Parryana*.

13. MICRORHYNCHAE.

Spikes several, cylindrical, often dense-flowered, sessile or short peduncled, erect, remote, the terminal staminate, the lateral pistillate or the uppermost staminate or androgynous; bracts foliaceous, sheathless; scales dark, obtuse; perigynia often stipitate, erect, compressed, roundish-ovate to elliptical, more or less prominently nerved, granulated, often scabrous along the upper margins, pale green, the beak mostly minute, entire to emarginate; stigmata 2.

Perigynia compressed; beak not bent horizontally.

Spikes sessile.

Perigynia several-nerved; spikes remote.

Perigynia stipitate, deciduous; beak entire.

38. *C. vulgaris*.

Perigynia persistent; beak bidentate.

44. *C. nebraskensis*.

Perigynia 2-nerved, not deciduous; spikes contiguous.

39. *C. rigida*.

Spikes peduncled.

Spikes short; scales spreading, acuminate, longer than the scabrous roundish perigynia.

40. *C. chimaphila*.

Spikes long and cylindric, remote.

Perigynia rhombic, entirely beakless.

37. *C. rhomboidea*.

Perigynia beaked.

Perigynia stipitate, oval.

41. *C. acutina*.

Perigynia sessile, obovate to broadly elliptic.

43. *C. variabilis*.

Perigynium turgid, with a beak bent horizontally; spikes sessile or nearly so.

45. *C. scopulorum*.

14. AEORASTACHYAE.

Spikes several, short, but dense-flowered, long-peduncled and drooping, somewhat remote, the terminal staminate, the lateral gynaeceandrous; bracts narrow, sheathless; scales dark-colored, lanceolate-acuminate, longer than the perigynium, which is stipitate, erect, orbicular to obovate gibbous, papillose, nerved, with a short, entire beak; stigmata 3.

One species.

46. *C. magellanica*.

15. CENCHROCARPAE.

Spikes several, loose-flowered, peduncled, but erect, contiguous, the terminal staminate or gynaeceandrous, the lateral pistillate; bracts foliaceous, sheathing; scales dark or greenish; perigynium erect, turgid, glabrous, distinctly several-nerved, the beak short or none; stigmata 3.

Terminal spike staminate or gynaeceandrous; perigynium globose, orange-colored, beakless or nearly so.

47. *C. aurea*.

Terminal spike staminate; perigynium obovate, greenish, abruptly beaked, with the orifice hyaline.

48. *C. Torreyi*.

16. LEOCHLAENAE.

Spike one, lax and few-flowered, androgynous; scales hyaline, mucronate; perigynium erect, pale-green, stipitate with a short beak or beakless.

Perigynium many-nerved, elliptical, emarginate, beakless.

49. *C. polytrichoides*.

Perigynium oval, two-nerved, shortly beaked.

50. *C. Geyeri*.

17. ATHROCHLAENAE.

Spike one, dense and many-flowered, androgynous, the pistillate portion squarrose at maturity; scales lanceolate to oblong, deciduous; perigynium shining, brown, reflexed at maturity, ovate to linear-oblong, prominently stipitate, nerveless, tapering into a long beak; stigmata mostly 3.

Rootstock creeping, stoloniferous; leaves flat; perigynium ovate, the beak two-lobed.

51. *C. nigricans*.

Rootstock caespitose, matted; leaves very narrow, involute; perigynium linear-oblong, the beak obliquely cut.

52. *C. pyrenaica*.

18. STENOCARPAE.

Spikes several, very dark, dense-flowered, borne on long, capillary peduncles, more or less drooping, the terminal gynaeceandrous, the lateral pistillate; scales very dark, acuminate; perigynium purplish, erect, attenuated at both ends, compressed, nerveless, the beak long, serrulate, with the orifice obliquely cut to bifid, hyaline; stigmata 2 or 3.

One species.

53. *C. misandra*.

19. LAMPROCHLAENAE.

Spike one, short and few-flowered, androgynous; scales broad, brownish; perigynium obovate to elliptical, obscurely nerved or nerveless, the beak short, with the orifice entire or obliquely cut; stigmata 3.

Spike dull-brown; perigynium erect or slightly spreading at maturity, obovate, shortly beaked or beakless, the orifice entire. 54. *C. rupestris*.

Spike shining, reddish-brown; perigynium horizontally bent at maturity, turgid, coriaceous, obscurely nerved, the short beak with hyaline orifice. 55. *C. obtusata*.

20. ELYNANTHAE.

Spike single, androgynous, the pistillate portion few-flowered; scales very broad; perigynium membranaceous, whitish to brown, erect, sessile, oval to obovoid, pubescent or ciliate above, the beak short, with the orifice entire or obliquely cut; stigmata 3.

Spike silvery-shining, light-brown; perigynium oval, pubescent, the beak entire. 56. *C. filifolia*.

Spike reddish-brown; perigynium obovoid, attenuated at both ends, the beak ciliate, obliquely cut. 57. *C. elynoides*.

21. SPHAERIDIOPHORAE.

Spike one, the plant dioecious or monoecious, or several, the terminal staminate, the lateral pistillate; the latter few-flowered, roundish, mostly sessile or the basal long-peduncled; bracts foliaceous, sheathless; scales acuminate, often mucronate, green to blackish; perigynium dark-green, stipitate or sessile, obovate to globose, pubescent, obscurely nerved, the beak mostly short, obliquely cut or bidentate, with the teeth erect; stigmata 3.

Spikes solitary; beak short, obliquely cut.

Dioecious; spike very dark, many-flowered; perigynium strigosely hairy, obovate to oval. 58. *C. scirpoidea*.

Monoecious; spike androgynous, silvery-shining; perigynium minutely pubescent, broadly elliptic. 59. *C. oreocharis*.

Spikes several.

Rhizome stoloniferous; spikes dark-colored, sessile or nearly so; perigynium globose, abruptly beaked; beak short, entire or 2-lobed. 60. *C. pennsylvanica*.

Rhizome caespitose; spikes peduncled, light-green to brown.

Perigynium oval, stipitate; beak bifid. 61. *C. Rossii*.

Perigynium globose; beak long, obliquely cut. 62. *C. umbellata*.

22. TRICHOCARPAE.

Spikes several, cylindrical, dense-flowered, sessile or the lowest one peduncled, but erect, remote, the terminal and uppermost lateral staminate, the others pistillate; bracts foliaceous, long and sheathing; scales purplish or brown, mucronate to aristate; perigynia erect, sessile, ovate to ovate-lanceolate, turgid, more or less pubescent, nerved, the beak prominent, bidentate; stigmata 3.

Perigynium ovate, densely pubescent. 63. *C. lanuginosa*.

Perigynium ovate-lanceolate, sparingly pubescent, the beak with very long, diverging teeth. 64. *C. aristata*.

23. HYMENOCOLAENAE.

Spikes several, androgynous or the terminal staminate, the lateral pistillate, not very dense-flowered, long-peduncled and drooping; bracts foliaceous, sheathing; scales hyaline, mucronate; perigynia erect to slightly

spreading, oval to elliptical, glabrous below, faintly nerved, the beak prominent, scabrous, bifid or bidentate; stigmata 3.

Spikes androgynous, light-green.

65. *C. Backii*.

Spikes staminate or pistillate on the same culm.

Spikes green; perigynium inflated, orbicular, the beak very long, linear, with the orifice obliquely cut.

66. *C. longirostris*.

Spikes shining, reddish-brown; perigynium elliptical, the beak entire.

67. *C. capillaris*.

24. SPIROSTACHYAE.

Spikes several, rather short, dense-flowered, peduncled, but erect, remote, squarrose at maturity, the terminal staminate, the lateral pistillate; bracts foliaceous, sheathing; scales light-brown, acuminate; perigynia greenish, spreading, oval to elliptical, turgid, sessile, nerved, glabrous, the beak long, scabrous, bifid; stigmata 3.

One species.

68. *C. viridula*.

25. ECHINOSTACHYAE.

Spike one, androgynous, or several, the terminal staminate, the lateral pistillate, cylindrical, dense-flowered, peduncled, but erect, squarrose at maturity; bracts foliaceous, very long, sheathing; scales lanceolate, light-brown; perigynium greenish, more or less inflated, nerved, glabrous, the beak long, bidentate; stigmata 3.

Spike one, androgynous; perigynium reflexed at maturity, narrowly lanceolate, orifice of beak oblique; rhacheola extended through orifice of the beak.

69. *C. microglochis*.

Spikes several, the terminal staminate, the lateral pistillate; perigynium ovate, much inflated, spreading at maturity, the beak bifurcate; rhacheola not extended.

70. *C. retrorsa*.

26. PHYSOCARPAE.

Spike one, androgynous, or several, the terminal and, sometimes, the uppermost lateral staminate, the others pistillate, cylindrical, sessile or the lowermost peduncled, dark-colored; bracts foliaceous, sheathless; scales lanceolate, acuminate, brownish or purple; perigynia shining, spreading, but not reflexed, membranaceous, globular to oblong-elliptical, inflated, sessile; nerved, the beak short, bidentate or merely emarginate; stigmata 2 or 3.

Spike single, androgynous; perigynium elliptical, tapering into a bidentate beak.

71. *C. Engelmannii*.

Spikes several.

Pistillate spikes cylindrical, often very long; perigynium inflated, many-nerved, oblong-elliptical, tapering into a cylindrical, bifurcate beak; stigmata 3.

72. *C. utriculata*.

Pistillate spikes short, blackish; perigynium slightly inflated, broadly ovate, nerveless, the beak short, emarginate; stigmata 2.

73. *C. pulla*.

27. RHYNCHOPHORAE.

Spikes several, cylindrical, very robust and dense-flowered, sessile or nearly so, mostly erect, contiguous, the terminal and, sometimes, the uppermost lateral staminate, the others pistillate; bracts foliaceous and very long, sheath-

ing; scales light-green, lanceolate, mucronate to aristate; perigynia greenish, erect, stipitate, membranaceous, ovate, much inflated, prominently nerved, glabrous or scabrous along the long beak, which is sharply bifurcate; stigmata 3.

Perigynium subglobose, glabrous, the beak bifurcate.

74. *C. monile*.

Perigynium very large, ovate, scabrous, prominently stipitate, the beak very long, bifurcate.

75. *C. lupulina*.

1. *Carex canescens* L. In bogs from Newf. to B. C., Va., Colo. and Ore.; also in Europe and Asia.—Alt. 8500–11,500 ft.—Marshall Pass; Lake Moraine; Trapper's Lake; Bob Creek, west of Mt. Hesperus; lat. 39°–41°.*

2. *Carex tenella* Schkur. In bogs, especially in the woods, from Newf. to B. C., N. J., Colo. and Calif.—Alt. 6000–11,500 ft.—North Park; Castle Cañon; Graymont; Colorado Springs; near Gray's Peak; near Pagosa Peak; Bob Creek, west of Mt. Hesperus; Twin Lakes; Little Beaver Creek; Mt. Elbert; along Quail Creek, near Stevens' Mine.

3. *Carex nardina* Fries. From Greenl. to Alaska, Colo. and Ore.; also Europe.—Alt. 10,000–12,000 ft.—Silver Plume; Mt. Elbert.

4. *Carex Deweyana* Schwein. In woods from N. S. to Ore., Pa. and N. Mex.—Alt. 4000–5000 ft.—Foot-hills, Larimer Co.

5. *Carex gynocrates* Wormskj. In bogs from Labr. and Alaska to Pa. and Colo.—Mosquito; South Park.

6. *Carex stellulata* Good. In bogs, Labr. and Alaska to Colo.; also Europe and Asia.—Wet Mountain Valley; Beaver Creek, Larimer Co.

7. *Carex sterilis* Willd. In moist soil from Newf. to B. C., Fla. and Calif.—Twin Lakes; South Park.

8. *Carex vulpinoidea* Michx. In swamps and wet meadows from N. B. to Man., Fla., Tex. and Colo.—Alt. 4000–5000 ft.—Brantly Cañon, Las Animas Co.

9. *Carex Hookeriana* Dew. Dry meadows from Sask. and B. C. to Colo. and Calif.—Alt. about 5000 ft.—Ft. Collins; Los Pinos; hills about Trinidad; dry meadows at Dix; gulch south of Rist Cañon.

10. *Carex occidentalis* Bailey. (*C. muricata Americana* Bailey.) In meadows from Colo. to N. M. and Ariz.—Alt. 6500–11,000 ft.—Near Pagosa Peak; Sierra Blanca; Montrose; Estes Park; Cedar Edge; Green Mountain Falls, near Pike's Peak; La Plata Cañon; Mt. Hesperus; gulch west of Soldier Cañon; lat. 39°–41°.

11. *Carex Hoodii* Boott. (*C. muricata confixa* Bailey.) In meadows from Mont. and B. C. to Colo. and Calif.—Alt. up to 10,000 ft.—Continental Divide, Routt Co.; foot of Mt. Richtofen, on the Michigan; Four-Mile Hill, Routt Co.; Hahn's Peak, Routt Co.; Rabbit-Ears, Larimer Co.

12. *Carex marcida* Dewey. In meadows from Man. to B. C., Neb., N. M. and Nev.—Alt. 4000–8500 ft.—Gunnison; Colorado Springs; mesas near Pueblo; Cucharas River, below La Veta; North Park; Pagosa Springs; Durango; Ft. Collins; Buena Vista; Twin Lakes; South Park; moist meadow, Fort Collins.

13. *Carex Sartwellii* Dewey. In swamps from Ont. to B. C., N. Y. and Utah.—South Park; lat. 39°–41°.

* See footnote on page 59.

14. *Carex Douglasii* Boott. In dry or alkaline soil from Man. to B. C., Neb., N. M. and Calif.—Alt. 5000–11,000 ft.—Antonito; Ruxton Dell; Gunnison; Ironton; plains near Denver; Cucharas Valley, near La Veta; Ft. Collins; La Plata Cañon; Grizzly Creek; pasture, Walton Creek flats; near Long's Peak; in the Spruce Zone, headwaters of Clear Creek.

15. *Carex teretiuscula* Good. In swamps and meadows from N. Sc. to B. C., Pa. and Colo.—Alt. up to 9000 ft.—Hamor's Lake.

16. *Carex scoparia* Schkur. In moist soil from N. S. to Man., Fla. and Colo.—Alt. up to 7000 ft.—Cheyenne Cañon.

17. *Carex athrostachya* Olney. In meadows and copses from Ass. and B. C. to Colo. and Calif.—Alt. 8000–11,000 ft.—North Park; Mt. Massive.

18. *Carex festiva* Dewey. Grassy mountain sides and meadows from Ass. and B. C. to Mex.—Alt. 6500–13,000 ft.—Marshall Pass; Sierra Blanca; Seven Lakes; Gunnison; Honnold; Cascade Cañon; Chrystal Park; West Indian Creek; headwaters of Sangre de Cristo Creek; Pass Creek; Dolores; La Plata Cañon; Bob Creek; Silver Plume; Andrew's Shetland ranch; Mosquito; foot of Mt. Richtofen, on the Michigan; Cameron Pass; Como; Chambers' Lake; Mt. Massive; White House Mountain; Mt. Lincoln; Pike's Peak; Gunnison; Georgetown; not uncommon in the Aspen and Spruce Zones from Silver Plume to Stevens' Mine; Gray's Peak.

C. festiva var. *pachystachya* Bailey.—Bob Creek; banks of streams, near Pagosa Peak.

C. festiva var. *stricta* Bailey.—Walton Creek flats, Routt Co.; Georgetown; Silver Plume.

C. festiva var. *decumbens* Holm.—Empire; mountains near Pagosa Peak; Mt. Kelso, near Stevens' Mine.

18a. *Carex ebenea* Rydb. (*Carex festiva Haydeniana* Bailey; not *C. Haydeniana* Oln.) In mountain meadows from Alb. and B. C. to Colo. and Utah.—Alt. 6000–12,000 ft.—Ironton; Alpine Tunnel; Pike's Peak; Bottomless Pit; Mt. Harvard; between Cheyenne Mountain and Seven Lakes; near Pagosa Peak; Silver Plume; Cameron Pass; Chambers' Lake; Clear Creek Cañon; Marshall Pass, Gunnison watershed; Mt. Kelso; Thompson's Cañon, on Long's Peak; Mt. Massive; Mt. Elbert.

19. *Carex petasata* Dewey. (*C. leporina* Bailey in Coulter's Man.) In mountain meadows from Alb. and Alaska to Colo. and Ore.—Alt. 10,000–13,000 ft.—Bottomless Pit; Chambers' Lake; Windy Point on Pike's Peak; Cameron Pass, at timber line; La Plata River; James' Peak; Mt. Massive; Mt. Kelso.

20. *Carex pratensis* Drej. In meadows from Ont. to Alaska, Mich. and Colo.—Alt. 5000–8500 ft.—Middle Park; Stone Basin, Larimer Co.; Howe's Gulch; Long's Peak.

21. *Carex siccata* Dewey. In dry fields and hills from Ont. to B. C., N. Y. and Calif.—Alt. 5000–10,000 ft.—Calvin Cañon; Mosquito; La Veta River; Silver Plume; Fort Collins; near Pike's Peak; between Bald Mountain and Seven Lakes; Chambers' Lake; Mt. Massive; Mt. Kelso; Lamb's ranch, near Long's Peak; Colorado Springs; Georgetown; South Park; Middle Park, along Grand River.

22. *Carex Liddonii* Boott. In meadows from Mont. and B. C. to Colo. and Calif.—Alt. about 7500 ft.—Mountains in Larimer Co.; Campton's ranch.

23. *Carex Bonplandii minor* Olney. (*C. illota* Bailey.) Mountains of Wyo., Colo. and Utah.—Alt. about 11,500 ft.—Headwaters of Clear Creek; Ethel Peak, Larimer Co.

24. *Carex straminea* Willd. In dry fields and on foot-hills from N. B. to Man., Pa. and Colo.—Alt. 4000-6500 ft.—Foot-hills, Larimer Co.; Clear Creek Cañon.

25. *Carex straminiformis* Bailey. In dry meadows and on hillsides from Wash. to Colo. and Calif.—Alt. about 9500 ft.—West Mancos Cañon.

26. *Carex festucea* Schkur. In rich soil from N. B. to Minn., Fla. and Colo.—Alt. 4000-5000 ft.—Windsor; Brantly Cañon, Las Animas Co.

27. *Carex stenophylla* Wahl. On dry plains from Man. to B. C., Iowa and Colo.—Alt. 4000-10,500 ft.—South Park; Turkey Creek and tributaries; mesas near Colorado Springs; Como; vicinity of Horsetooth; Georgetown.

28. *Carex incurva* Lightf. In alpine-arctic regions from Greenl. to Alaska and Colo.; also in Europe and Asia.—Alpine ridge, near Middle Park; Gray's Peak; Silver Plume.

29. *Carex alpina* Sw. In rocky places, in arctic or alpine regions from Lab. and Alaska to Ont. and Colo.—Alt. 8500-12,000 ft.—Seven Lakes; South Park; Ruxton Dell; Pike's Peak; La Plata River; Beaver Creek; Idaho Springs; Georgetown.

C. alpina var. *Stevenii* Holm.—Georgetown; Colorado Springs; Silver Plume; Middle Park; Lamb's ranch, near Long's Peak; between Graymont and Stevens' Mine; Gray's Peak.

30. *Carex melanocephala* Turcz. (*C. nova* Bailey.) In the mountains from Mont. to Colo.—Alt. 8500-12,000 ft.—Sierra Blanca; Middle Park; Alpine Tunnel; west side of Bald Mountain; Pike's Peak; Ouray; Upper La Plata River; Silver Plume; Oro City; Wet Mountain Valley; Chambers' Lake; Mt. Elbert; Mt. Kelso; headwaters of Clear Creek.

31. *Carex atrata* L. In arctic-alpine localities from Lab. and Alaska to Que., Colo. and Calif.—Alt. 11,500-13,000 ft.—Sierra Blanca; South Park; Long's Peak; Gray's Peak; lat. 39°-41°.

32. *Carex chalciolepis* Holm. Mountains of Colorado.—Alt. 8500-13,000 ft.—Marshall Pass; Ouray; Mt. Hesperus; Devil's Causeway; Cameron Pass; Silver Plume; Bottomless Pit; near Pagosa Peak; Little Kate Mine; West Spanish Peak; Bald Mountain; Pike's Peak; Estes Park; Empire; James' Peak; Mt. Massive; Mt. Elbert; Mt. Kelso; Long's Peak; Gray's Peak.

33. *Carex bella* Bailey. Mountains of Colo., Utah and Ariz.—Alt. 9000-11,500 ft.—Sierra Blanca; Upper La Plata River; Mt. Hesperus; Stage Coach Mountain; West Spanish Peak; South Park.

34. *Carex Parryana* Dewey. In alpine and arctic regions from Hudson Bay to B. C. and Colo.—Alt. 6500-10,000 ft.—South Park; Table Rock; Mosquito; South Pass; Twin Lakes; lat. 39°-41°.

35. *Carex Reynoldsii* Dewey. In mountain meadows from Mont. and Wash. to Colo. and Calif.—Foot of Mt. Richtofen, on the Michigan; Rabbit-Ear Range, Routt Co.

36. *Carex Buxbaumii* Wahl. In bogs from Newf. to Alaska, Ga. and Calif.—Twin Lakes; lat. 39°-41°.

37. *Carex rhomboidea* Holm. In alpine swamps of Colo.—Alt. 8500-9500 ft.—In swamps near Long's Peak; Twin Lakes.

38. *Carex vulgaris* Fries. (*C. Goodenovii* J. Gay.) In wet grounds from Newf. to Alaska, Pa. and Colo.—Alt. 6000–10,000 ft.—Silver Plume.

C. vulgaris var. *lipocarpa* Holm.—Columbine; Steamboat Springs, Routt Co.

39. *Carex rigida* Good. (*C. vulgaris alpina* Booth.) In the mountains from Alaska to Colo.—Alt. about 11,500 ft.—Headwaters of Clear Creek.

40. *Carex chimaphila* Holm. Alpine regions of Colorado.—Alt. 11,000–12,000 ft.—Alpine Tunnel; Long's Peak.

41. *Carex acutina* Bailey. Mountains from Mackenzie and Alaska to Colo. and Ore.—Alt. 8500–10,000 ft.—Foot of Mt. Richtofen, on the Michigan; Silver Plume; Georgetown; Graymont; Lamb's ranch, near Long's Peak; James' Peak.

42. *C. acutina* var. *petrophila* Holm.—Dry rocks near Graymont.

43. *Carex variabilis* Bailey. (*C. stricta* Bailey in Coulter's Man.) Wet meadows from Mont. to Colo.—Alt. 8500–11,500 ft.—Seven Lakes; Sierra Blanca; Ruxton Dell; Grizzly Creek; Twin Lakes; Leadville; Ute Pass; Empire; Cameron Pass; Georgetown; Mt. Massive; Mt. Kelso.

C. variabilis var. *sciaphila* Holm.—Mt. Massive, 11,000 ft.

44. *Carex nebraskensis* Dewey. In meadows from Nebr. to Ore. and N. M.—Alt. 4000–7000 ft.—Wahatoya Creek; Palmer Lake; near Pike's Peak; Colorado Springs; Ft. Collins; Oak Creek; Weston Pass; Twin Lakes; Monument Park.

45. *Carex scopulorum* Holm. (*C. Tolmici subsessilis* Bailey, in part.) Mountains of Colo.—Alt. 10,000–12,000 ft.—Sierra Blanca; Marshall Pass; Pike's Peak; Clark's Peak; Bottomless Pit; Mt. Harvard; Estes Park; Silver Plume; Mt. Massive; headwaters of Clear Creek; Stevens' Mine; Mt. Kelso; Gray's Peak.

46. *Carex magellanica* Lam. In bogs from Newf. to B. C., Pa. and Utah; also in Europe and South America.—Alt. about 8500 ft.—Estes Park.

47. *Carex aurea* Nutt. In wet meadows from Newf. to B. C., Pa., Utah and Wash.—Alt. 4000–11,000 ft.—Gunnison; Palsgrove Cañon; Seven Lakes; Green Mountain Falls; North Cheyenne Cañon; Wahatoya Creek; Piedra; Los Pinos; Georgetown; Elk River, Routt Co.; Mancos; West Mancos Cañon; North Park; Twin Lakes; Mt. La Plata; Clear Creek Cañon, near Graymont.

48. *Carex Torreyi* Tuck. In dry soil from N. Y. to N. W. T. and Colo.—Near Golden City.

49. *Carex polytrichoides* Willd. In bogs and swamps from Newf. to B. C., Fla., Tex. and Ore.—Alt. up to 10,000 ft.—Twin Lakes; lat. 39°–41°.

50. *Carex Geyeri* Boott. Dry mountain sides from Mont. and B. C. to Colo. and Ore.—Alt. 8500–11,000 ft.—Bob Creek, west of Mt. Hesperus; North Park, near Teller; foot of Mt. Richtofen, on the Michigan; Chambers' Lake; lat. 39°–41°.

51. *Carex nigricans* C. A. Mey. On the higher mountains from Alb. and Alaska to Colo. and northern Calif.—Alt. 10,000–13,000 ft.—Telluride; Thompson's Cañon, on Long's Peak; headwaters of Clear Creek; lat. 39°–41°.

52. *Carex pyrenaica* Wahl. On the higher mountains from Alb. and Alaska to Colo. and Ore.; also in Europe.—Alt. 11,500–14,000 ft.—Sierra

Blanca; Mt. Harvard; Gray's Peak; Cameron Pass; Telluride; Pagosa Peak; Long's Peak; lat. 39°-41°.

53. *Carex misandra* R. Br. In arctic and alpine regions from Lab. to Alaska and Colo.; also in Europe and Asia.—Alt. about 12,000 ft.—Gray's Peak.

54. *Carex rupestris* All. In alpine and arctic regions from Greenl. to Alaska and Colo.—Alt. 11,500-13,000 ft.—Pike's Peak; Cumberland Mines; Gray's Peak; James' Peak; Mt. Elbert; Long's Peak; Floral Mountain; lat. 39°-41°.

55. *Carex obtusata* Lilj. On dry hills and prairies from Newf. and B. C. to Colo.—Alt. 8000-10,000 ft.—Ruxton Dell; Georgetown; Chicken Creek, west of Mt. Hesperus; South Park; Long's Peak; lat. 39°-41°.

56. *Carex filifolia* Nutt. On dry plains from Man. to B. C., Neb., Colo. and Calif.—Alt. 4000-10,000 ft.—Lat. 39°-41°; Ute Pass; Table Rock; Silver Plume.

57. *Carex elynoides* Holm. Mountains of Colo.—Alt. 11,500-13,000 ft.—Alpine Tunnel; near Pagosa Peak; Mt. Princeton, Chaffee Co.; Mt. Massive and Mt. Kelso.

58. *Carex scirpoides* Michx. In rocky soil from Greenl. to Alaska, Mass. and Calif.—San Juan Co.; South Park; lat. 39°-41°.

59. *Carex oreocharis* Holm. Mountains of Colo.—Alt. about 8500 ft.—Lamb's ranch, near Long's Peak.

60. *Carex pennsylvanica* Lam. In dry soil from N. B. to Alb., N. C. and Colo. In the state only represented by *var. vespertina* Bailey.—Alt. 5000-8500 ft.—New Windsor; Colorado Springs; foot-hills, Larimer Co.; Ft. Collins; headwaters of Pass Creek; Como; vicinity of Horsetooth; Trail Creek and Rist Cañon; Ute Pass; mountains near Central City; Dixon Cañon; Horsetooth Gulch.

61. *Carex Rossii* Boott. Mountains from Alb. and B. C. to Colo.—Alt. 6000-11,500 ft.—Middle Park; Chambers' Lake; Cameron Pass; Little Kate Mine, La Plata Mountains; Silver Plume; near Pagosa Peak; Colorado Springs; Twin Lakes; headwaters of Beaver Creek; Mt. Massive; headwaters of Clear Creek.

62. *Carex umbellata* Schkur. In dry soil from N. Sc. to Ore., N. J. and Colo. In the state represented by *var. brevirostris* Boott.—Alt. about 6000 ft.—Near Golden City.

63. *Carex lanuginosa* Michx. In swamps and wet meadows from N. Sc. to B. C., N. J., N. M. and Calif.—Alt. 4000-8500 ft.—Gunnison; Twin Lakes; Windsor; Turkey Creek and tributaries; mountains in Larimer Co.; Durango; swales, Ute Pass; Cañon City; Campton's ranch; Pagosa Spring; Estes Park.

64. *Carex aristata* R. Br. In bogs from Ont. to Ore., N. Y. and Utah.—Alt. 4000-6000 ft.—Saguache Creek; river bank, near Fort Collins.

65. *Carex Backii* Boott. In woods and thickets from Ont. to Man., N. Y. and Colo.—Alt. up to 5500 ft.—Ft. Collins; lat. 39°-41°.

66. *Carex longirostris* Torr. On banks and in moist thickets from N. B. to N. W. Terr., Pa. and Colo. In the state represented by *var. minor* Boott.—Gulch west of Pennocks and south of Rist Cañon; lat. 39°-41°.

67. *Carex capillaris* L. In alpine-arctic regions from Greenl. to Alaska, N. H. and Colo.—Alt. 10,000–12,000 ft.—South Park; West Spanish Peak; Pike's Peak; Georgetown; Devil's Causeway; West Mancos Cañon; Twin Lakes; Middle Park; Thompson's Cañon, on Long's Peak; Silver Plume; lat. 39°–41°.

68. *Carex viridula* Michx. In bogs and among wet rocks from Newf. to Wash., Pa., Colo. and Utah.—Hamor's Lake.

69. *Carex microglochin* Wahl. In arctic-alpine regions from Greenl. to B. C. and Mont.; also in Colo., Europe and Asia.—Lat. 39°–41°.

70. *Carex retrorsa* Schkur. In swamps and wet meadows from N. S. to Ore., Pa. and Colo.—Durango.

71. *Carex Engelmannii* Bailey. Alpine slopes of Colo.—Alt. about 12,000 ft.—Silver Plume; Upper Clear Creek region.

72. *Carex utriculata* Boott. In marshes from Lab. to B. C., Del. and Calif.—Alt. 5,000–10,000 ft.—Gunnison; Veta Pass; South Park; Bijou Basin; Steamboat Springs; Bob Creek, west of Mt. Hesperus; Hamor's Lake, north of Durango; Cascades near Pike's Peak; Twin Lakes; Upper Laramie River; near Chambers' Lake; Little Beaver Creek.

C. utriculata var. *minor*.—Not uncommon with the type.

73. *Carex pulla* Good. (*C. saxatilis* L.) In arctic-alpine regions from Greenl. to Alaska and Colo.; also in Europe and Asia.—Alt. 7,000–10,000 ft.—Seven Lakes; Deep Creek Lake; White River Plateau.

74. *Carex monile* Tuck. In marshes and wet meadows, N. Sc. to B. C., N. J. and Calif.—Alt. up to 10,000 ft.—Twin Lakes; Upper Laramie River; Chambers' Lake; Hamor's Lake.

75. *Carex lupulina* Muhl. In swamps from Ont. to Mont., Fla. and Tex.—Alt. up to 6,500 ft.—Durango.

Order 14. ARALES.

Plants normal, with flowers on a spadix.

Fam. 20. ARACEAE.

Plants reduced to small floating thalloid structures, with only 1–3 flowers.

Fam. 21. LEMNACEAE.

Family 20. ARACEAE. ARUM FAMILY.

1. ACORUS L. SWEET FLAG, CALAMUS.

1. *Acorus Calamus* L. In marshes and streams from N. S. to Minn., Fla., Colo. and Texas.—Alt. 3,500–4,500 ft.—Fort Collins.

Family 21. LEMNACEAE Dumort. DUCK-WEED FAMILY.

1. LEMNA L. DUCK-WEED.

Fronds long-stalked, mostly submerged, forming large masses.

1. *L. trisulca*.

Fronds short-stalked or sessile, floating on the surface.

Fronds pale and usually strongly gibbous beneath.

2. *L. gibba*.

Fronds green or purplish beneath, not gibbous.

3. *L. minor*.

1. *Lemna trisulca* L. In springs and running water from N. S. to Sask., B. C., N. J., Tex. and Cal.; also in the Old World.—Alt. 3,500–8,000 ft.—

Parlin, Gunnison Co.; Van Boxle's ranch, above Cimarron; near Grand Lake; Spicer, Larimer Co.

2. *Lemna gibba* L. In ponds from Nebr. to Cal., Tex. and Mex.; also in the Old World and Australia.—Alt. 3500–12,500 ft.—Pike's Peak; near Boulder.

3. *Lemna minor* L. In still water and slow streams from Lab. to Alaska, Fla. and Mex.; also in the Old World and Australia.—Alt. 4000–9000 ft.—Trinidad; along Uncompahgre River, near Ouray; Iron-ton Park, 9 miles south of Ouray; Hayden, Routt Co.

Order 15. XYRIDALES.

Calyx and corolla free, of very different members; stamens free.

Fam. 22. COMMELINACEAE.

Calyx and corolla of quite similar members and partly united; stamens partly adnate to the perianth.

Fam. 23. PONTEDERIACEAE.

Family 22. COMMELINACEAE. SPIDERWORT FAMILY.

Perfect stamens 3, rarely 2; petals unequal; bracts spathe-like.

1. COMMELINA.

Perfect stamens 6, rarely 5; petals all alike; bracts leaf-like.

2. TRADESCANTIA.

1. COMMELINA. DAY-FLOWER, DEW-FLOWER.

1. *Commelina crispa* Wooton. In sandy soil from Mo. to Neb., Colo., Tex. and N. M.—Alt. 4000–6500 ft.—Cañon City.

2. TRADESCANTIA L. SPIDERWORT.

Flowers 1–1.5 cm. in diameter; plant glabrous or calyx and pedicels sparingly glandular; leaves 4–6 mm. wide.

1. *T. scopulorum*.

Flowers 2–3 cm. in diameter; calyx and pedicels usually densely glandular-pubescent; leaves 6–8 mm. wide.

2. *T. occidentalis*.

1. *Tradescantia scopulorum* Rose. In moist ground from Black Hills of S. D. to Colo., N. M. and Ariz.—Alt. 4000–5000 ft.—Boulder; Denver; Colorado City.

2. *Tradescantia occidentalis* Britton. On sand-hills and in rocky ground from Neb. to Mont., Tex. and N. M.—Alt. 4000–6000 ft.—Denver; Eads; New Windsor; Fort Collins; Walsenburg; near Boulder; Pennock's mountain range; Spring Cañon; Horsetooth Gulch; Wray.

Family 23. PONTEDERIACEAE Dumort. PICKERELI-WEED FAMILY.

1. HETERANTHERA Willd.

1. *Heteranthera limosa* (Sw.) Willd. In shallow water or mud from Va. to Neb., Fla. and La. and Colo.; also W. Ind., Mex. and Cent. Am.—Alt. 4000–5500 ft.—Between Longmont and Loveland; eastern Larimer County; west side of Cache La Poudre; Limnath Co.

Order 16. LILIALES.

Styles present, distinct or united; stigmas terminal.

Styles distinct; capsule septicidal.

24. MELANTHACEAE.

Styles united, often very short or obsolete during anthesis.

Capsules septicidal; petals and sepals very unlike.

30. CALOCHORTACEAE.

Capsules loculicidal; petals and sepals nearly alike.

Sepals and petals chaffy.

25. JUNCACEAE.

Sepals and petals not chaffy.

Herbs with bulbs, corms or rootstocks.

Plants with bulbs or corms, or short, erect rootstocks.

Flowers in umbels, at first included in and later subtended by a scarious involucre.

26. ALLIACEAE.

Flowers solitary or racemose, or in *Leucocrinum* by shortening of the stem umbel-like, without involucre.

27. LILIACEAE.

Plants with elongated, horizontal rootstocks.

28. CONVALLARIACEAE.

Shrubby plants with woody caudices or trees.

29. DRACAENACEAE.

Styles wanting.

Flowers perfect; plants not climbing.

Leaves and bracts alternate; plants with bulbs; fruit a capsule.

30. CALOCHORTACEAE.

Leaves or leaf-like bracts whorled; plants with rootstock; fruit a berry.

31. TRILLIACEAE.

Flowers dioecious; plants climbing or trailing.

32. SMILACACEAE.

Family 24. MELANTHACEAE R. Br. BUNCH-FLOWER FAMILY.

Plants with rootstock and large oval clasping leaves; petals and sepals glandless.

1. VERATRUM.

Plants with bulbs and linear leaves; petals and sepals with more or less distinct glands.

Ovary partly inferior; glands obcordate.

2. ANTICLEA.

Ovary wholly superior; glands obovate or semiorbicular.

3. TOXICOSCORDION.

1. VERATRUM L. WHITE HELLEBORE.

Petals oblong-lanceolate.

1. *V. tenuipetalum*.

Petals oval.

2. *V. speciosum*.

1. *Veratrum tenuipetalum* Heller. Along stream in Colorado.—Alt. about 9000 ft.—“Colorado”; Rabbit-Ear Pass; Fish Creek Falls.

2. *Veratrum speciosum* Rydb. (*V. californicum* Wats., and Coulter; not Durand.) In Colorado also erroneously called Skunk Cabbage. In mountain meadows, along streams, from Mont. to Wash., Colo. and Calif.—Alt. 6500–10,000 ft.—Breckenridge; Marshall Pass; Indian Creek Pass; Wahatoya Creek, near La Veta; Pagosa Peak; Columbine; Oak Mesa.

2. ANTICLEA Kunth.

Petals and sepals 7–8 mm. long, 7–13-nerved.

1. *A. elegans*.

Petals and sepals 5–6 mm. long, 3–7-nerved.

2. *A. coloradensis*.

1. *Anticlea elegans* (Pursh) Rydb. (*Zygadenus elegans* Pursh; *Z. dilatatus* Greene) In meadows from Sask. to Alaska, Colo. and Nev.—Alt. 6500–12,500 ft.—La Veta; Indian Creek Pass; La Plata Mountains; Chambers' Lake; North Cheyenne Cañon; Larimer County; Marshall Pass; Al-

pine; Ruxton Park; Minnehaha; Mount Garfield; mountains above Graymont; Medicine Bow Mountain; Silverton.

2. *Anticlea coloradensis* Rydb. In the mountains from Colo. to Utah and N. M.—Alt. 8500–12,000 ft.—Idaho Springs; Leroux Creek; Mt. La Plata; Marshall Pass; Steamboat Springs; Estes Park; Middle Park; Pike's Peak; high mountains about Empire; divide between Arkansas River and Bayou Salade; foot-hills, Larimer Co.; above Beaver Creek; Rist Cañon; bank of the Michigan; Gore Pass; Stove Prairie Hill; Redstone; Baxter's ranch; Buffalo Pass; Medicine Bow Mountains.

3. **TOXICOSCORDION** Rydb. POISON CAMASS, DEATH CAMASS, HOGS' POTATO.

Petals and sepals rounded or obtuse at the apex; leaves 3–5 mm. wide.

Petals and sepals acute at the apex; leaves over 5 mm. wide. 1. *T. gramineum*.
2. *T. falcatum*.

1. *Toxicoscordion gramineum* Rydb. (*Zygadenus venenosus* Wats., in part.) Gravelly hillsides from Sask. to Ida. and Colo.—Alt. 5000–7000 ft.—Howe's Gulch.

2. *Toxicoscordion falcatum* Rydb. (*Zygadenus Nuttallii* Coulter, in part; not A. Gray.) Hills and mesas of Colorado.—Alt. 5000–7500 ft.—Fort Collins; La Veta; Walsenburg; Los Pinos; Denver; Spring Cañon near Cal-loway Ranch; Palmer Lake; Boulder.

Family 25. **JUNCACEAE** Vent. RUSH FAMILY.

Leaf-sheaths open; capsules 1- or 3-celled, with axial or parietal placentae; seeds many.

Leaf-sheaths closed; capsule 1-celled, with basal placentae; seeds 3. 1. **JUNCUS**.
2. **JUNCOIDES**

1. **JUNCUS** L. RUSHES.

I. Lower bracts of the inflorescence terete, erect, appearing like a continuation of the stem; inflorescence therefore apparently lateral.

A. Flowers several in a more or less compound panicle; seeds apiculate (EFFUSI).

Stem light-green, striate when dry, on account of the free hypodermal fibro-vascular bundles; sepals and petals green; stamens 3.

1. *J. filiformis*.

Stem dark-green or at the base purplish, not striate; sepals and petals dark purplish-brown; stamens 6.

Inflorescence congested; branches 1–3 cm. long; petals and sepals acute or short-acuminate, almost equal in length.

2. *J. balticus montanus*.

Inflorescence open; branches 4–8 cm. long; sepals long-acuminate and much exceeding the acute petals.

3. *J. balticus vallicola*.

B. Flowers 1–5, of which one is subsessile and the others pediceled (SUBTRI-FLORE).

Upper sheath merely bristle-pointed; petals and sepals with green backs and dark-brown margins.

4. *J. Drummondii*.

Upper sheaths leaf-bearing; green backs of the petals and sepals less prominent. Sepals and petals linear-lanceolate, light-brown; capsule acute.

5. *J. Parryi*.

Sepals and petals broadly lanceolate, very dark-brown; capsule retuse.

6. *J. Hallii*.

II. Lower bracts not appearing as a continuation of the stem, or if so channeled on the upper side; inflorescence terminal.

A. Leaves neither septate nor equitant.

1. Leaves not fistulose; flowers many.

- a. Flowers bracteolate, inserted singly on the branches of the inflorescence; leaves narrowly linear, either flat or subterete and channeled.

a. Perennials; stem simple (TENUX).

Seeds long, caudate; leaves subterete, with a shallow groove above.

7. *J. Vaseyi*.

Seeds not caudate; leaves flat, but often involute; lunate in cross-section.

Auricles at the summit of the sheaths membranous, whitish; petals and sepals scarcely spreading.

Auricles scarcely produced beyond the insertion, scarcely scarious; inflorescence open.

Perianth 3-4 mm. long, equalling the capsule.

8. *J. interior*.

Perianth 4.5-5 mm. long, exceeding the capsule.

9. *J. arizonicus*.

Auricles conspicuously produced beyond the point of insertion; flowers few, congested.

10. *J. confusus*.

Auricles cartilaginous, yellowish-brown; petals and sepals spreading.

11. *J. Dudleyi*.

β. Annuals; stem branching (BUFONII).

12. *J. bufonius*.

- b. Flowers not bracteolate, in true heads on the branches of the inflorescence; leaves broad and grasslike (GRAMINIFOLII).

13. *J. longistylis*.

2. Leaves fistulose (i. e., hollow); flowers few, in small heads (CASTANEI).

Stem leafy only at the base, but the uppermost leaf often with a long sheath; petals and sepals about 4 mm. long; leaves about 1 mm. in diameter; lower bract of inflorescence membranous.

14. *J. triglumis*.

Stem more or less leafy; leaves about 2 mm. in diameter; perianth 5-6 mm. long; lower bracts foliaceous.

15. *J. castaneus*.

B. Leaves septate.

1. Leaves terete, not equitant.

- a. Septa poorly developed; heads 1-3 (see *J. triglumis* and *J. castaneus*).

- b. Septa well developed; heads usually several (in *J. Mertensianus* usually only 1) (NODOSI).

Inflorescence with short branches; flowers echinate-spreading or the lowest of the head reflexed; capsule narrowly lanceolate.

Heads 7-8 mm. in diameter; leaf-blades erect; petals usually longer than the sepals.

16. *J. nodosus*.

Heads over 10 mm. in diameter; leaf-blades usually spreading; sepals longer than the petals.

17. *T. Torreyi*.

Inflorescence with elongated branches or in *J. Mertensianus* with a single head; flowers erect-ascending; capsule oblong.

Heads several; leaves terete; seeds not caudate.

18. *J. truncatus*.

Heads solitary or rarely 2-3; leaves somewhat flattened; seed usually caudate.

19. *J. Mertensianus*.

2. Leaves equitant, laterally flattened, so that one edge is towards the stem (ENSIFOLII).

Flower-clusters numerous, small, 5-12-flowered, light-colored.

20. *J. brunnescens*.

Flower-clusters few, 15-25-flowered.

Flowers greenish or light-brown; ligules of the sheath usually without auricles.

21. *J. parous*.

Flowers fuscous or very dark-brown; ligules of the sheath produced into small auricles.

22. *J. saximontanus*.

1. *Juncus filiformis* L. In wet places from Lab. to Alaska, Pa., Utah and Wash.—Reported from Colorado (Coulter), but doubtful.

2. *Juncus balticus montanus* Engelm. In meadows and marshes from Lab. to Wash., Colo. and Utah.—Alt. 5000-11,000 ft.—North Park; Clear Creek bottoms, above Georgetown; east of Ft. Collins; Hardin's ranch; Penn's Gulch; Lake City; Cottonwood Creek; Buena Vista; Sangre de Cristo; Palmer Lake; Green Mountain; Georgetown; Andrew's Shetland ranch; Garland; Gunnison; Alpine Tunnel; Julesburg; Ruxton Dell, Pike's Peak; Cucharas River; Cambres; Moon's ranch; along the Conejos River, north of Antonito; Leroux Creek; Table Rock; Chambers' Lake; Gore Pass.

3. *Juncus balticus vallicola* Rydb. In wet meadows from Mont. to Alaska, Colo., Utah and Wash.—Alt. 4000-7500 ft.—Denver; Andrews' Shetland ranch; Mancos; Dolores.

4. *Juncus Drummondii* Mey. On wet alpine slopes from Mont. to Alaska, Colo. and Calif.—Alt. 8500-13,000 ft.—Red Mountain, south of Ouray; Georgetown; Windy Point and Bottomless Pit, Pike's Peak; Sierra Blanca; Alpine Tunnel; Cameron Pass; Pagosa Peak; Ironton; Berthoud Pass; Buffalo Pass; Park Range; mountains west of Cameron Pass; Buffalo Pass; Anita Peak, Routt Co.; summit of North Park Range.

5. *Juncus Parryi* Engelm. On alpine slopes from Mont. to Wash., Colo. and Calif.—Alt. 10,000-13,000 ft.—Headwaters of Clear Creek; Gray's Peak.

6. *Juncus Hallii* Engelm. On alpine slopes of Colo. and Wyo.—Alt. about 10,000 ft.—Marshall Pass.

7. *Juncus Vaseyi* Engelm. In meadows from Me. to Minn. and Colo.—Grand Lake.

8. *Juncus interior* Wiegand. (*J. tenuis* Coulter, in part; not Willd.) In meadows from Ills. to Wyo., Mo. and Colo.—Alt. 4000-6000 ft.—Grand Lake; Fort Collins; plains and foot-hills near Boulder; foot-hills, Larimer Co.; Poudre Cañon; bank of Poudre, La Porte.

9. *Juncus arizonicus* Wiegand. In meadows from Texas to Col. and Ariz.—Alt. up to about 5000 ft.—New Windsor.

10. *Juncus confusus* Coville. (*J. tenuis congestus* Engelm.; in part.) In wet meadows from Mont. to Wash. and Colo.—Alt. 6500-10,000 ft.—Chicken Creek; North Park; mountain north of Steamboat Springs; Fort Collins; Chambers' Lake; Grizzly Creek.

11. *Juncus Dudleyi* Wiegand. (*J. tenuis* Coulter, in part; not Willd.) In meadows from Me. to Wash., N. Y. and Mexico.—Alt. 4000-8500 ft.—Platte River, Denver; Gunnison; Mancos; Cheyenne Mountain; Ft. Collins.

12. *Juncus bufonius* L. In wet and sandy soil from Lab. to Alaska, Fla., Calif. and Mex.; also in the Old World.—Alt. 4000-9000 ft.—Georgetown; Gunnison; Fort Collins; Wahatoya Creek; Villa Grove; Hebron; plains and foot-hills, near Boulder.

13. *Juncus longistylis* Torr. In meadows from Alb. to Ida., Nebr., N. M., Calif. and Mex.—Alt. 4000-10,000 ft.—Dolores; Chambers' Lake; Moon's ranch; Trimble Springs, Durango; Upper Larimie River; Pike's Peak; headwaters of Pass Creek; Ruxton Dell; La Veta; Gunnison; Blind Cañon; Placer; Sangre de Cristo Creek; Denver; South Cheyenne Cañon; headwaters of Clear Creek; Gunnison; Como; Leroux Creek; Graymont.

14. *Juncus triglumis* L. In arctic and alpine regions from Lab. to Alaska, N. Y. and Colo.—Alt. about 11,500 ft.—Seven Lakes; headwaters of Clear Creek.

15. *Juncus castaneus* Smith. In arctic and alpine regions from Greenl. to Alaska and Colo.—Alt. 9500–12,500 ft.—Seven Lakes; headwaters of Clear Creek; Ruxton Park.

16. *Juncus nodosus* L. In wet meadows, along rivers and in marshes, from N. Sc. to Mackenzie River, B. C., Va. and Nev.—Alt. 4000–6500 ft.—Trimble Springs; Durango; Colorado Springs; Ft. Collins; Poudre Cañon.

17. *Juncus Torreyi* Coville. In wet places, especially in sandy soil, from N. Y. to Mont., Tex. and Ariz.—Alt. 4000–6500 ft.—Plains and foot-hills, near Boulder; Huerfano Valley; Walsenburg; Julesburg; Fort Collins; Cañon City; Denver; Larimer County; Colorado Springs.

18. *Juncus truncatus* Rydb. (*J. alpinus insignis* of Coulter's Man.; in part.) In wet places in Colo. and Wyo.—Alt. 6000–9000 ft.—Meadow Height; Elk River, Routt Co.; Grizzly Creek.

19. *Juncus Mertensianus* Bong. In wet mountain meadows from Mont. to Alaska, Colo. and Calif.—Alt. 8500–11,000 ft.—Pagosa Peak; North Park; Marshall Pass; Breckenridge; Georgetown; Iron-ton; Red Mountain, Ouray; Buffalo Pass; Park Range.

A form with 2 or 3 heads was collected on the Upper La Plata River. This has been taken for the var. *paniculatus* Engelm., to which it scarcely belongs.

20. *Juncus brunnescens* Rydb. (*J. xiphioides montanus* Engelm., in part.) In wet meadows from Colo. to Nev., N. M. and Ariz.—Pagosa Spring.

21. *Juncus parous* Rydb. In wet mountain meadows from Colo. to N. M.—Garland; North Cheyenne Cañon; Steamboat Springs; Pike's Peak.

22. *Juncus saximontanus* A. Nelson. (*J. xiphioides montanus* Engelm., mainly.) In wet meadows from Alb. to B. C., Colo. and Calif.—Alt. 8500–10,000 ft.—La Plata River; Garland; Pagosa Springs; Sangre de Cristo Creek; Carlton Lake, near Grand Lake; Ouray; Redcliffe; Rogers; Mount Harvard; Steamboat Springs; Iron-ton Park, Ouray; foot of Mount Richtofen, on the Michigan; Steamboat Springs; Graymont; Gypsum Creek Cañon; Hebron, North Park.

2. JUNCODES Adans. WOOD-RUSH.

Flowers on slender pedicels in a corymbiform inflorescence.

Flowers subsessile in headlike or spikelike clusters.

Spikelets peduncled, forming a corymb.

Flowers light-yellow.

Flowers brown or ferruginous.

Spikelets subsessile, forming a compound spike.

Plant tall, 4–5 dm. high; inflorescence subcapitate; stem-leaves broad and flat; bractlets not ciliate.

Plant 1–2, rarely 3–4 dm. high; spike usually elongated and nodding; stem-leaves narrow, attenuate; bractlets ciliate.

1. *J. parviflorum*.

2. *J. comosum*.

3. *J. intermedium*.

4. *J. subcapitatum*.

5. *J. spicatum*.

1. *Juncoides parviflorum* (Ehrh.) Coville. (*Luzula spadicea parviflora* and v. *melanocarpa* Meyer.) In wet meadows from Greenl. to Alaska, Colo. and Calif.—Alt. 8500–11,500 ft.—Beaver Creek; White River Plateau; Silver Plume; Crystal Park; Villa Grove; Cameron Pass; Mt. Robinson; Seven Lakes, Pike's Peak; Pagosa Peak; Caribou; Bald Mountain; Salida; headwaters of Sangre de Cristo Creek; Little Kate Mine, La Plata Mountains.

2. *Juncoides comosum* (Meyer) Sheld. (*Lusula comosa* Meyer.) In wet meadows from Mont. to Alaska, Colo. and Cal.—Alt. about 8500 ft.—Crystal Park.

3. *Juncoides intermedium* (Thuill.) Rydb. (*Lusula campestris* Am. auth.) In woodlands and meadows from Newf. to B. C., Colo. and Calif.—Alt. 8500–10,000 ft.—North Park; Chambers' Lake; Middle Park.

4. *Juncoides subcapitatum* Rydb. Along mountain streams, near the timber line. Found only at the type locality.—Silver Plume.

5. *Juncoides spicatum* (L.) Kuntze. (*Lusula spicata* Desv.) On hillsides and in mountain meadows from Greenl. to B. C., N. H. and Calif.—Alt. 10,000–13,000 ft.—Cameron Pass; Pagosa Peak; La Plata Mountains; Pike's Peak; West Spanish Peak; Seven Lakes; Mt. Harvard; Mt. Garfield; Gray's Peak.

Family 26. **ALLIACEAE** Batch. ONION FAMILY.

1. **ALLIUM** L. ONION, GARLIC, LEEK, CHIVES.

I. Bulb crowning a persistent rootstock.

Leaves terete and hollow.

Leaves flat or channeled, not hollow.

Umbels not nodding; petals and sepals long-acuminate.

1. *A. sibiricum*.

Umbels nodding; petals and sepals obtuse or acute.

Leaves rounded-convex on the back, not keeled.

Leaves almost flat and keeled.

Umbels few-flowered; leaves 1–2 mm. wide.

Umbels many-flowered; leaves 3–5 mm. wide.

2. *A. brevistylum*.

3. *A. recurvatum*.

4. *A. neo-mexicanum*.

5. *A. cernuum*.

II. Bulbs without rootstock.

Outer bulb coat fibrous.

Umbels bulblet-bearing.

Umbels not bulblet-bearing.

Capsule not crested; involucre usually 3-leaved.

Capsule more or less crested.

6. *A. rubrum*.

7. *A. Nuttallii*.

Bracts broadly ovate in anthesis, not reflexed; flowers white or light-rose; several layers of the bulb-coat fibrous.

Petals and sepals over 1 cm. long; peduncles often 2 or 3 from the loose sheaths; bracts 3.

Petals and sepals less than 1 cm. long; peduncles single from the close sheaths; bracts usually 2.

8. *A. macropetalum*.

Plant 3–6 dm. high; pedicels 12–15 mm. long; petals and sepals 6–8 mm. long.

9. *A. Geyeri*.

Plant 1–3 dm. high; pedicels 8–12 mm. long; petals and sepals about 5 mm. long.

10. *A. reticulatum*.

Bracts lanceolate, usually 3, soon reflexed; only the outer bulb-coat fibrous; flowers red-purple.

11. *A. Pikeanum*.

Outer bulb-coat not fibrous, but often more or less reticulated.

Petals long-acuminate, serrulate.

Petals acute, not serrulate.

12. *A. acuminatum*.

13. *A. Brandegei*.

1. *Allium sibiricum* L. (*A. Schoenoprasum* Am. auth., mostly; not L.) In dry places from Me. to Alaska, N. Y., Colo. and Oreg.—Alt. 5000–8500 ft.—Upper Laramie River; Northern State line.

2. *Allium brevistylum* S. Wats. In wet woodlands from Mont. to Colo. and Utah.—Alt. 6500–9000 ft.—Cañon of the Cache la Poudre; North Park, near Teller; North Platte, near Hebron; Cerro Summit, near Chambers Lake; forks of Poudre and Big South.

3. *Allium recurvatum* Rydb. (*A. cernuum* of Coulter's Man., mainly.) On banks and hillsides from the Black Hills of S. D. to B. C. and N. M.—Alt. 5000–8500 ft.—Colorado Springs; Cheyenne Mountain; Pike's Peak; Gunnison; Garden of the Gods; North Cheyenne Cañon; Engelmann Cañon; Parlin, Gunnison County; Minnehaha; Yampa; Villa Grove; Cerro Summit; Larimer County; mountains between Sunshine and Ward; Howe's Gulch; Redstone; Poudre Cañon; Clear Creek bottoms, below Georgetown; Empire.

4. *Allium neo-mexicanum* Rydb. In rocky places of Colo., N. M. and Ariz.—Headwaters of Clear Creek.

5. *Allium cernuum* Roth. In rich, rocky soil from N. Y. to Sask, Mont., W. Va. and Colo., but very rare in the Rocky Mountain region.—Pagosa Springs.

6. *Allium rubrum* Osterhout. In rich ground from Colorado and Wyoming.—North Park, Continental Divide; in pastures along Walton Creek.

7. *Allium Nuttallii* S. Wats. In dry, rocky or sandy plains from S. D. to Wyo., Kans. and Colo.—Alt. 4000–6000 ft.—Colorado Springs; Denver; southwest of Ward, Boulder County.

8. *Allium macropetalum* Rydb. In the mountains of Colo.—Palisades.

9. *Allium Geyeri* S. Wats. (*A. dictyotum* Greene; *A. reticulatum deserticola* Jones.) In dry soil and hillsides from N. D. to Wash. and N. M.—Alt. 5000–11,500 ft.—Upper La Plata Cañon; Indian Creek Pass; Pagosa Springs; near Ironton; Mt. Abram; Red Mountain road, near Ouray; Cimarron; Swallows, between Pueblo and Cañon City; Dixon Cañon; Ft. Collins; mountains above Manitou; Como and vicinity; gulch west of Penstock's; Spring Cañon; Moon's ranch; Dillon Cañon; Medicine Bow Mountains.

10. *Allium reticulatum* Fraser. In dry, gravelly soil from Sask. to Idaho, Colo. and Utah.—Alt. 5000–8500 ft.—Mesas near Pueblo; La Veta; Aztec; Arboles; South Park; Soldier Cañon; Horsetooth Mountain; Quimby; Horsetooth Gulch.

11. *Allium Pikeanum* Rydb. In rocky places in Colo.—Alt. 11,000–13,000 ft.—Pike's Peak: near Halfway House; Bald Mountain; Peak Valley.

12. *Allium acuminatum* Hook. In dry soil from Mont. to B. C., Col., Ariz. and Ore.—Alt. 6500–8500 ft.—Mancos; Cerro Summit; Honnold; Durango; Dolores.

13. *Allium Brandegei* S. Wats. From Ida. to Wash., Colo. and Ore.—Elk Mountains; Steamboat Springs; Rabbit-Ear Range, Routt Co.

Family 27. LILIACEAE Adans. LILY FAMILY.

Plant with a short rootstock; flowers subumbellate on subterranean pedicels from the crown of the rootstock; petals and sepals united into a long tube.

1. LEUCOCRINUM.

Plant with bulbs or corms, either leafy-stemmed or scapiferous; petals and sepals distinct or nearly so.

Bulb scaly; plant tall, leafy.

Anthers versatile; petals and sepals oblanceolate, clawed with a linear nectariferous groove.

2. LILIUM.

Anthers fixed near the base, slightly if at all versatile; petals and sepals obovate-oblanccolate, not clawed, in ours mottled; nectary a shallow pit.

3. FRITILLARIA.

Bulb tunicated, anthers strictly basifixed.

Leaves 2, basal or nearly so; flowers nodding.

4. ERYTHRONIUM.

Leaves several, alternate; flowers not nodding.

5. LLOYDIA.

1. LEUCOCRINUM Nutt.

1. *Leucocrinum montanum* Nutt. In sandy soil from S. D. to Mont. and Colo.—Alt. 4000–6500 ft.—Denver; headwaters of Clear Creek; Boulder; Pike's Peak; Colorado Springs; Larimer County; New Windsor; Table Rock; Howe's Gulch; gulch west of Dixon Cañon; Spring Cañon; bank of Cache la Poudre River; Rist Cañon; bluffs north of La Porte; hills west of Soldier Cañon; vicinity of Horsetooth Gulch; Boulder; Colorado City.

2. LILIUM L. LILY.

Leaves linear.

1. *L. umbellatum*.

Leaves lanceolate.

2. *L. montanum*.

1. *Lilium umbellatum* Pursh. Hills, among bushes, from Hudson Bay to B. C., Ky. and Colo.—Baxter's ranch; Empire.

2. *Lilium montanum* A. Nelson. On hills, among bushes, from Mont. to Colo.—Alt. 6500–10,000 ft.—Crystal Park; West Spanish Peak; Hamor's Lake, north of Durango; Larimer County; Long Gulch; Stove Prairie Hill; Rist Cañon; Laramie River, at Sherwood's.

3. FRITILLARIA L. FRITILLARY, TIGER LILY.

1. *Fritillaria atropurpurea* Nutt. On hillsides from N. Dak. to Ida., Colo. and Calif.—Alt. 4000–9500 ft.—Poverty Ridge, near Cimarron; Lamb's ranch.

4. ERYTHRONIUM. ADDER'S-TONGUE, DOG-TOOTH VIOLET.

1. *Erythronium parviflorum* (S. Wats.) Gooding. (*E. grandiflorum parviflorum* S. Wats.) On rich hillsides from Wyo. to Colo. and Utah.—Alt. 8500–11,500 ft.—Cameron Pass; Bear Creek Divide; West La Plata Mountains; North Park; Grand Mesa; mountain west of North Park; source of Leroux; Rabbit-Ears, Larimer Co.

5. LLOYDIA Salisb.

1. *Lloydia serotina* (L.) Sweet. In exposed alpine or arctic regions from Mont. to Alaska and Colo.; also in the Old World.—Alt. 10,000–14,000 ft.—Crystal Lake; Arapahoe Peak; headwaters of Clear Creek; Red Mountain; Saddle Cliff, Pike's Peak; Alpine Tunnel; Carson; West Spanish Peak; Mt. Hesperus; mountains above Graymont; Franklin; mountains northeast of Boreas.

Family 28. CONVALLARIACEAE Link. LILY-OF-THE-VALLEY FAMILY.

Sepals and petals distinct.

Flowers white, in terminal racemes or panicles; anthers introrse, stem simple.

1. VAGNERA.

Flowers axillary or terminal, solitary or in small umbelliform clusters; anthers extrorse or opening laterally; stem branched.

Flowers axillary, greenish-white; filaments slender; anthers acute.

2. *STREPTOPUS*.

Flowers terminal, yellow; filaments dilated; anthers obtuse.

3. *DISPORUM*.

Sepals and petals partially united into a tube; flowers axillary.

4. *SALOMONIA*.

1. *VAGNERA* Adans. FALSE SOLOMON'S SEAL, WILD SPIKENARD.

Inflorescence paniculate.

Leaf-blades acuminate; the lower contracted at the base into distinct petioles.

1. *V. racemosa*.

Leaf-blades acute; all sessile and more or less clasping.

2. *V. amplexicaulis*.

Inflorescence racemose.

Petals and sepals linear or linear-lanceolate.

3. *V. leptopetala*.

Petals and sepals oblong-lanceolate.

Pedicels short, slightly if at all longer than the flowers or the fruit; leaves lanceolate, acute.

4. *V. stellata*.

Pedicels long; the lower often 2-3 times as long as the flowers or the fruit;

leaves narrowly lanceolate, long-attenuate.

5. *V. liliacea*.

1. *Vagnera racemosa* (L.) Morong. (*Smilacina racemosa* Desf.) In moist woods from N. S. to Wash., Ga. and Calif.—Alt. 6500-8500 ft.—Ojo; Ouray; Boulder Cañon.

2. *Vagnera amplexicaulis* (Nutt.) Morong. (*Smilacina amplexicaulis* Nutt.) In rich woods from Mont. to B. C., Colo. and Calif.—Alt. 6000-9000 ft.—La Plata River Cañon; Big Creek Gulch, Routt Co.; Black Cañon; Poverty Ridge, Cimarron; Redcliffe; Ouray; Veta Mountain; headwaters of Pass Creek; near Pagosa Peak; Gore Pass; banks of Fish Creek; gulch south of Boulder; Hematite.

3. *Vagnera leptopetala* Rydb. In dark, wooded cañons of Colo.—Alt. 9000-10,000 ft.—Headwaters of Sangre de Cristo Creek; Dark Cañon; Chicken Creek, West La Plata Mountains; near Pagosa Peak; Los Pinos.

4. *Vagnera stellata* (L.) Morong. (*Smilacina stellata* Desf.) In open woodlands from Newf. to Sask., Mont., Va. and Colo.—Alt. 4000-12,000 ft.—Ojo; Halfway House, Pike's Peak; Colorado Springs; Ft. Collins; banks of Poudre River, north of La Porte; Horsetooth Gulch; mountain north of Steamboat Springs; Franklin; Campton's ranch.

5. *Vagnera liliacea* (Greene.) Rydb. (*Smilacina sessilifolia* of Coulter's Man. in part, not Nutt.) In moist woodlands from S. D. to B. C., N. M. and Calif.—Alt. 7500-9000 ft.—Chaparral-covered hills southeast of Ouray; Van Boxle's Ranch, above Cimarron; headwaters of Sangre de Cristo Creek; Pike's Peak.

2. *STREPTOPUS* Michx. TWISTED-STALK.

1. *Streptopus amplexifolius* (L.) DC. In moist wood from Greenl. to Alaska, N. C., Colo. and Ore.—Alt. 6500-10,000 ft.—Cameron Pass; Rabbit-Ear Range; Upper La Plata River; near Pagosa Peak; Sangre de Cristo Creek; Keblar Pass; Columbine; Grant Lake; Jack Brook; mountains above Beaver Creek; Bosworth's ranch; Stove Prairie; Big Creek Gulch; Steamboat Springs.

3. *DISPORUM* Salisb.

1. *Disporum trachycarpum* (S. Wats.) B. & H. (*Prosartes trachycarpa* S. Wats.) On mountain sides and in cañons from Man. to B. C., Colo. and

Ariz.—Alt. 7500–11,000 ft.—Chaparral-covered hills southeast of Ouray; mountains about Ouray; near Pagosa Peak; Tunnel Mountain; gulch south of Boulder; foot-hills near Ft. Collins; Big Creek Gulch, Routt Co.; Eldora; Baltimore.

4. SALOMONIA.

1. *Salomonium commutatum* (R. & S.) Britton. (*Polygonatum giganteum* Dietr.) River banks and moist woods from R. I. to Utah, Ga. and Ariz.—Locality not given.

Family 29. DRACAENACEAE Link. YUCCA FAMILY.

Flowers perfect, large; ovary many-ovuled and capsule many-seeded. 1. YUCCA. Flowers polygamo-dioecious; ovules 2 in each cell; capsule often 1-seeded.

2. NOLINA.

1. YUCCA. YUCCA, SPANISH BAYONET.

Fruit a dry capsule.

Leaves narrowly linear, very long; style swollen, green.

1. *Y. glauca*.

Leaves linear-lanceolate, short; style not swollen, white.

2. *Y. Harrimaniae*.

Fruit fleshy.

3. *Y. baccata*.

1. *Yucca glauca* Nutt. (*Y. angustifolia* Pursh.) On dry plains and hills from Nebr. to Mont., Tex. and Ariz.—Alt. 4000–6000 ft.—Colorado Springs; Walsenburg; near Boulder; Poudre flats, west of Ft. Collins.

2. *Yucca Harrimaniae* Trelease. On arid plains and hills of Utah and Western Colorado.—Alt. about 6500 ft.—Cimarron; Durango.

3. *Yucca baccata* Torr. On arid plains from Colo. to Nev., Tex. to Calif.; also in Mex.—Alt. 4000–5500 ft.—Trinidad; hills south of Dolores; Durango.

2. NOLINA Michx.

1. *Nolina Greenii* S. Wats. Dry mesas, Colo.—Alt. about 5000 ft.—Trinidad.

Family 30. CALOCHORTACEAE Rydb. MARIPOSA LILY FAMILY.

1. CALOCHORTUS Pursh. MARIPOSA LILY, SEGO LILY.

Petals abruptly acuminate; glands oblong.

1. *C. acuminatus*.

Petals rounded or merely acute at the apex.

Anthers obtuse; glands not broader than long.

2. *C. Nuttallii*.

Anthers acute; glands broader than long.

3. *C. Gunnisonii*.

1. *Calochortus acuminatus* Rydb. On dry hills from Mont. to Colo. and Utah.—Alt. about 6500 ft.—Mancos.

2. *Calochortus Nuttallii* T. & G. On hillsides from Mont. to Colo. and Calif.—Alt. 6000–7000 ft.—Cimarron.

3. *Calochortus Gunnisonii* S. Wats. In meadows from Mont. to Colo. and Ariz.—Alt. 5000–10,000 ft.—North Park, near Teller; Boulder; headwaters of Clear Creek; Middle Park; Mancos; Como; Piedra; Veta Pass; Jack's Cabin, Gunnison watershed; Yampa; Ruxton Dell, near Pike's Peak; La Veta; Villa Grove; Table Rock; Four Mile Hill; Spring Cañon; Horsetooth Gulch; Brant's Soda Spring, near North Platte; Trinidad; Dixon Cañon.

Family 31. **TRILLIACEAE** Lindl. TRILLIUM FAMILY.1. **TRILLIUM** L. TRILLIUM, WAKE-ROBIN.

1. *Trillium ovatum* Pursh. In rich woods from Mont. to Wash., Colo. and Calif.—Alt. about 9000 ft.—Columbine.

Family 32. **SMILACACEAE** Vent. SMILAX FAMILY.1. **NEMEXIA** Raf. SMILAX, CARRION-FLOWER.

1. *Nemexia lasioneuron* (Hook.) Rydb. (*Smilax lasioneuron* Hook.; *S. herbacea* Am. authors, in part; *Nemexia herbacea melica* A. Nelson) Among bushes from Sask. to western Nebr. and Colo.—Horsetooth Gulch; along Buckhorn Creek, Larimer Co.; Colorado Springs; South Cheyenne Cañon.

Order 17. **AMARYLLIDALES.**Family 33. **IXIACEAE** Ecklon. IRIS FAMILY.

Styles alternate with the stamens; petals and sepals nearly equal.

1. **SISYRINCHIUM.**

Styles opposite and arching over the stamens, sepals much larger than the petals, reflexed.

2. **IRIS.**1. **SISYRINCHIUM** L. BLUE-EYED GRASS.

Outer bracts of the spathe little or not at all longer than the inner.

Small and slender; flowers 10 mm. or less long; capsule less than 3 mm. high.

1. *S. halophilum.*

Stouter; flowers 12 mm. or more long; capsule 4 mm. or more high.

2. *S. occidentale.*

Outer bracts of the spathe conspicuously prolonged, sometimes 2-3 times as long as the inner one.

Petals and sepals not emarginate, narrowed to the aristulate tip.

3. *S. alpestre.*

Petals and sepals more or less retuse or abruptly contracted to the aristulate apex.

4. *S. angustifolium.*

1. *Sisyrinchium halophilum* Greene. In alkaline meadows from Idaho to Colo. and Calif.—Colorado (*Bicknell*).

2. *Sisyrinchium occidentale* Bickn. In wet meadows from Mont. to Idaho and Colorado.—North Park; Doyles; Sapinero.

3. *Sisyrinchium alpestre* Bickn. In mountain meadows of Colorado.—Alt. about 8000 ft.—Parlin, Gunnison Co.

4. *Sisyrinchium angustifolium* Miller. In meadows and around streams from Newf. to the Mackenzie River and B. C., south to Va. and Colo.—Alt. 4000-9000 ft.—Gunnison; Arboles; near Seven Lakes, Pike's Peak; Crystal Park; Dolores; Mancos; Chicken Creek; Grayback mining camps; Cu-charas River, below La Veta; Sangre de Cristo Creek; Ft. Collins; North Boulder Peak.

2. **IRIS** L. IRIS, BLUE FLAG, FLEUR-DE-LIS.

1. *Iris missouriensis* Nutt. In meadows, marshes and along streams from N. Dak. to Ida., Colo. and Calif.—Alt. 8000-10,000 ft.—Mancos; Marshall

Pass; Crystal Park; Veta Mountain; Stove Prairie; river-flats near Ft. Collins; Ruxton ranch; Hematite; Cherry Creek; Andrew's ranch.

Order 18. ORCHIDALES.

Family 34. ORCHIDACEAE Lindl. ORCHID FAMILY.

I. Fertile stamens 2; lip a large inflated sack.

1. *CYPRIPEDIUM*.

II. Fertile stamen 1.

A. Pollinia caudate at the base, attached to a viscid disk or gland.

Gland surrounded by a thin membrane; lip toothed at the apex.

2. *COELOGLOSSUM*.

Gland naked; lip entire.

Sepals 3-5 nerved; plants with rootstocks or fibrous-fleshy roots.

Stem scapiform, 1-leaved at the base; anther sacks divergent.

3. *LYSIELLA*.

Stem leafy; anther-cells parallel or nearly so.

4. *LIMNORCHIS*.

Sepals 1-nerved; plants with rounded or oblong, undivided corms.

5. *PIPERIA*.

B. Pollinia not produced into caudicles.

1. Pollinia granulose or powdery.

Anthers operculate.

6. *EPIPACTIS*.

Anthers not operculate.

Leaves green throughout, borne on the stem.

Leaves alternate; spike mostly twisted.

7. *IBIDIUM*.

Leaves 2, opposite; spike not twisted.

8. *OPHRYS*.

Leaves white-reticulate, basal.

9. *PERAMIMUM*.

2. Pollinia waxy or smooth.

Plants with corms (solid bulbs); rarely if ever with coralloid roots; leaves solitary, not scale-like.

Leaf cauline; lip not sackate; flowers small, racemose.

10. *ACHROANTHES*.

Leaf basal; lip sackate; flowers large, solitary.

11. *CYTHEREA*.

Plants with coralloid roots; leaves numerous, reduced to scales.

12. *CORALLORRHIZA*.

1. *CYPRIPEDIUM* L. LADIES' SLIPPER.

Leaves alternate; flowers solitary, terminal, or also in the axils of the upper leaves.

Lip 2-2.5 cm.; rarely 3 cm. long.

1. *C. parviflorum*.

Lip 3.5-4 cm. long.

2. *C. pubescens*.

Leaves 2, opposite or nearly so; flowers usually several, in a contracted bracted raceme.

3. *C. fasciculatum*.

1. *Cyripedium parviflorum* Salisb. In woods from Newf. to B. C., Ga. and Colo.—La Veta; Piedra.

2. *Cyripedium pubescens* Willd. In rich wood from N. S. to Minn., Ga. and Nebr.—Stove Prairie Hill.

3. *Cyripedium fasciculatum* Kell. In rich soil from Wash. to Calif. and Colo.—Estes Park.

2. *COELOGLOSSUM* Hartm. LONG-BRACTED ORCHIS.

1. *Coeloglossum bracteatum* (Willd.) Parl. In boggy woods from N. B. to Alaska, N. C. and Colo.—Exact locality not given.

3. *LYSIELLA* Rydb.

1. *Lysiella obtusata* (Pursh) Rydb. In boggy places in the woods from Newf. to Alaska, N. Y. and Colo.—Alt. 8500–11,500 ft.—Chicken Creek, West La Plata Mountains; North Park; Clear Creek; camp on Little Beaver Creek; bank of Michigan, North Park.

4. *LIMNORCHIS* Rydb. BOG ORCHID.

Connective of the anther narrow; anther cells therefore close together; spur not longer than the tip.

Flowers greenish or purplish.

Spur $\frac{1}{2}$ – $\frac{3}{4}$ as long as the lip, very saccate.

Lip linear or nearly so, 5–7 mm. long; ovary slightly curved; spike elongated.

Lip lanceolate, fleshy 4–5 mm. long; ovary strongly curved; spike usually short.

Spur almost equalling the lip, scarcely saccate.

Flowers whitish.

Connective of the anther broad; anther cells therefore distant; spur much exceeding the tip.

1. *L. stricta*.

2. *L. purpurascens*.

3. *L. viridiflora*.

4. *L. borealis*.

5. *L. laxiflora*.

1. *Limnorchis stricta* (Lindl.) Rydb. In bogs from Mont. to Alaska, Colo. and Wash.—Alt. 8500–10,000 ft.—Upper La Plata; Jack Brook; Twin Lakes; Manitou.

2. *Limnorchis purpurascens* Rydb. On rich brook-banks in the mountain woods of Colo.—Alt. 7500–11,000 ft.—Gunnison; Parlin; Iron Mountain; Georgetown; Como; mouth of Cheyenne Cañon; Barnes' Camp; camp on Little Beaver Creek; swamp above Beaver Creek; Franklin; mountains north of Steamboat Springs.

3. *Limnorchis viridiflora* (Cham.) Rydb. (*Habenaria hyperborea* S. Wats. and of Coult. Man.; not R. Br.) In bogs from Alb. to Alaska and Colo.—Alt. 6500–10,000 ft.—McCoy; Ouray; Gunnison; La Veta; Cascade; Piedra; Wahatoya Creek; Georgetown; West La Plata Mountains; Clear Creek; Barnes' Camp; mountains above Ouray; mountain north of Steamboat Springs.

4. *Limnorchis borealis* (Cham.) Rydb. (*Habenaria dilatata* of Coult. Man.) In bogs from Mont. to Alaska, Colo. and Wash.—Alt. 8500–10,000 ft.—Chambers' Lake; Columbine; Veta Pass; Graymont; Gore Pass; summit of North Park Range.

5. *Limnorchis laxiflora* Rydb. In bogs from Ore. to Colo. and Utah.—Uncompahgre Mountains; Los Pinos; Franklin.

5. *PIPERIA* Rydb.

1. *Piperia unalaschensis* (Spreng.) Rydb. (*Habenaria Unalaschensis* S. Wats.) In damp rich woods from Mont. to Alaska, Colo. and Calif.—Alt. about 8500 ft.—South Boulder Peak.

6. *EPIPACTIS* R. Br. HELLEBORINE.

1. *Epipactis gigantea* Dougl. In rich woodlands from Mont. to B. C., Western Tex. and Calif.—Alt. about 8500 ft.—Glenwood Springs.

7. **IBIDIUM** Salisb. LADIES' TRESSES.

Callosities at the base of the lip obsolete; lower sepals coherent with the petals and upper sepal.

1. *G. stricta*.

Callosities nipple-shaped, directed downward; lower sepals free.

2. *G. porrifolia*.

1. *Ibidium strictum* (Rydb.) House. (*Spiranthes Romansoffiana* of Coulter's Man.; not Cham.; *Gyrostachys stricta* Rydb.) In springy places, rich hillsides and open woods from Newf. to Alaska, Pa. and Colo.—Alt. 5000–10,000 ft.—Gunnison; West Cliff; Cabin Cañon; Jack's Cabin; Parlin; Wahatoya Creek; Marshall Pass; Twin Lakes; Empire.

2. *Ibidium porrifolium* (Lind.) Rydb. In marshes from Ida. to Wash., Colo. and Cal.—Camp Harding, near Pike's Peak.

8. **OPHRYS** (Tourn.) L. TWAYBLADE.

Lip broad at the base, with distinct auricles, slightly cleft at the apex; leaves oblong to oval.

1. *L. borealis*.

Lip narrow and narrowed at the base, 2-cleft for about half its length into linear-lanceolate lobes, without auricles, but with a pair of divergent teeth; leaves reniform.

2. *L. nephrophylla*.

1. *Ophrys borealis* (Morong) Rydb. (*Listera borealis* Morong) In woods from Hudson Bay to the Mackenzie and Mont.; also in Colo.—Saguache Range.

2. *Ophrys nephrophylla* Rydb. (*Listera cordata* Am. auth., partly; not R. Br.; *Listera nephrophylla* Rydb.) In woods from Mont. to Alaska, Colo. and Ore.—Alt. 10,000–11,500 ft.—Larimer Co.; Slide Rock Cañon, West La Plata Mountains; Beaver Creek; Franklin.

9. **PERAMIUM** Salisb. RATTLE-SNAKE PLANTAIN.

Lip evidently sackate, with recurved margins.

1. *P. ophioides*.

Lip scarcely sackate, with incurved margins.

2. *P. Mensiesii*.

1. *Peramium ophioides* (Fernald) Rydb. In woods from Prince Edwards Island to the Black Hills of S. D., N. C. and Colo.—Alt. about 8500 ft.—Minnehaha; Pike's Peak.

2. *Peramium Mensiesii* (Lindl.) Morong. (*Goodyeara Mensiesii* Lindl.) In mountain woods from Que. to B. C.; N. Y. and Calif.—Alt. 7500–9000 ft.—Mt. Abram, Ouary; Pagosa Peak.

10. **ACROANTHES** Raf. ADDERS' MOUTH.

1. *Acroanthes monophylla* (L.) Greene. In woods from Que. to Minn., Pa. and Colo.—Alt. about 7500 ft.—Glen Mountain Falls.

11. **CYTHEREA** Salisb. CALYPSO.

1. *Cytherea bulbosa* (L.) House. (*Calypso borealis* Salisb.) In cold woods from Lab. to Alaska, Me. and Calif.—Alt. 8000–10,000 ft.—Telluride; East Indian Creek.

12. CORALLORRHIZA R. Br. CORAL-ROOT.

The small spur or callosity adnate to the ovary.

Lip entire; whole plant yellow.

1. *C. ochroleuca*.

Lip with 2 lobes or teeth below the middle; plant brownish.

Lobes or teeth small; lip unspotted; spur very small.

2. *C. Corallorrhiza*.

Lobes prominent; lip spotted; spur manifest.

3. *C. multiflora*.

Spur or callosity lacking.

4. *C. Vreelandii*.

1. *Corallorrhiza ochroleuca* Rydb. In woods of western Nebr. and Colo.—Alt. about 8500 ft.—Near La Veta.

2. *Corallorrhiza Corallorrhiza* (L.) Karst. (*C. innata* R. Br.) In woods from N. Sc. to Alaska, Ga. and Colo.—Alt. about 10,000 ft.—Caribou.

3. *Corallorrhiza multiflora* Nutt. In woods from N. S. to Alaska, Fla. and Calif.—Alt. 4000-9500 ft.—Crystal Forest; Damfino Creek; Ouray; Cascade Cañon; West Indian Creek; Sangre de Cristo Creek; near Pagosa Peak; North Boulder Peak; Elizabethtown.

4. *Corallorrhiza Vreelandii* Rydb. In wet woods of Colo. and N. M.—Alt. about 8500 ft.—Veta Mountain; Pennock's mountain ranch.

Sub-class 2. DICOTYLEDONES.

Order 19. SALICALES.

Family 35. SALICACEAE Lindl. WILLOW FAMILY.

Bracts incised; disk cup-shaped; stamens usually 10 or more; stigmata elongated and expanded; winter buds with several scales. 1. *POPULUS*.
Bracts entire; disk reduced to 1 or more small glands; stamens less than 10, usually 2; stigmas short, not expanded; winter-buds with one scale each. 2. *SALIX*.

1. *POPULUS* L. POPLAR, COTTONWOOD, ASPEN.

Petioles strongly flattened laterally.

Leaf-blades suborbicular, acute or very short acuminate. 1. *P. tremuloides*.

Leaf-blades broadly deltoid or cordate, abruptly long acuminate.

Teeth of the leaves few, less than 10 on each side; cup of the pistillate flowers 6-8 mm. broad; pedicels equalling or exceeding the capsule.

2. *P. Wislizeni*.

Teeth of the leaves many, more than 10 on each side; cup of the pistillate flowers less than 6 mm. broad; pedicels shorter than the capsule.

3. *P. occidentalis*.

Petioles terete or nearly so.

Petioles half as long as the blade or longer; blades ovate or rhombic, abruptly long-acuminate. 4. *P. acuminata*.

Petioles about one-third as long as the blades or less; blades lanceolate, not abruptly acuminate. 5. *P. angustifolia*.

1. *Populus tremuloides* Michx. In open woods and on mountain sides from Newf. to Alaska, Tenn. and Nev.—Alt. 6000-10,000 ft.—Near Georgetown; Cheyenne Cañon; dry rocks, Cheyenne Mountain; Minnehaha; chaparrel-covered hills southeast of Ouray; South Park; near Pagosa Peak; South Cheyenne Cañon; Colorado Springs; Ojo; foot-hills, Larimer Co.; Chicken Creek, West La Plata Mountains; Rist Cañon; Fort Collins; Redstone; Howe's Gulch.

2. *Populus Wislizeni* (S. Wats.) Sarg. In cañons and on river banks from Tex. to Colo. and Ariz.—Alt. 4000-9000 ft.—River bottoms, Arboles; Grand Junction; plains, Colorado Springs.

3. *Populus occidentalis* (Rydb.) Britton. (*P. deltoides occidentalis* Rydb.; *P. angulata* Port. & Coult.; not Ait.) In river valleys and hillsides from Sask. to Mont., Kans. and Ariz.—Alt. 4000-7000 ft.—Plains near Denver; Walsenburg; Palisade; near Boulder; Lyons; Fort Collins; along the Arkansas River, Lamar; Eldora to Baltimore.

4. *Populus acuminata* Rydb. On river bottoms and in cañons from the Black Hills of S. D. to Ida., N. M. and Nev.—Alt. 4000-6000 ft.—Fort Collins; Walsenburg; Denver; Hardin's ranch; Redstone.

5. *Populus angustifolia* James. In cañons and along streams from N. D. to Wash., N. M. and Calif.—Alt. 6000-11,000 ft.—Pike's Peak; Upper Platte; plains near Denver; South Cheyenne Cañon, Colorado Springs; Gunnison;

Cimarron; chaparral-covered hills southeast of Ouray; Turkey Creek and tributaries; Fort Collins; Mancos; Garden of the Gods; near Boulder; Rist Cañon; banks of the Poudre River; Redstone; Hardin's ranch; Trinidad.

2. *SALIX* L. WILLOW.

Capsule glabrous.

Filaments hairy, at least below; bracts caducous, light yellow.

Stamens 3-7; stipe slender, 2-5 times as long as the nectaries.

Petioles without glands; leaves serrulate, thin. I. AMYGDALINAE.

Petioles with glands; leaves densely glandular-serrate.

II. PENTANDRAE.

Stamens 2; stipe very short or none.

III. LONGIFOLIAE.

Filaments glabrous; bracts persistent, seldom light yellow.

IV. CORDATAE.

Capsule hairy.

Filaments hairy.

Leaf-blades linear to lanceolate not very veiny; bracts caducous; tall shrubs. III. LONGIFOLIAE.

Leaf-blades oval or suborbicular, very veiny; bracts persistent; depressed shrubs. IX. RETICULATAE.

Filaments glabrous; bracts more or less persistent.

Capsule rostrate, distinctly stipitate; style none or short, always shorter than the stipe.

Stipe equalling or exceeding the bracts; styles $\frac{1}{2}$ mm. or less long.

V. ROSTRATAE.

Stipe shorter than the bracts; styles usually about 1 mm. long.

VI. BRACHYSTACHYAE.

Capsule scarcely rostrate, subsessile or if stipitate, stipe shorter than the style.

Style evident, at least $\frac{1}{2}$ mm. long.

Leaves permanently white-silky or tomentose, at least beneath.

VII. PELLITAE.

Leaves either green or grayish beneath.

VIII. ARCTICAE.

Style none; depressed shrubs with entire strongly veined leaves.

IX. RETICULATAE.

I. AMYGDALINAE.

Leaf-blades narrowly lanceolate; petioles short.

1. *S. Wrightii*.

Leaf-blades broadly lanceolate; petioles slender.

2. *S. amygdaloides*.

II. PENTANDRAE.

Represented only by

3. *S. Fendleriana*.

III. LONGIFOLIAE.

Capsule glabrous.

Capsule sessile.

4. *S. exigua*.

Capsule stipitate.

Leaves permanently silky.

Leaves 3-5 mm. wide; ovary without hairy swelling at the apex.

5. *S. luteosericea*.

Leaves 2-3 mm. wide; ovary with a hairy swelling at the apex.

6. *S. stenophylla*.

Leaves glabrous when mature.

7. *S. linearifolia*.

Capsule more or less pubescent.

Capsule sparingly silky, often becoming glabrous in age.

Leaves permanently silky; bracts not densely silky.

5. *S. luteosericea*.

Leaves glabrous or nearly so when mature; bracts densely silky; aments dense.

8. *S. sessiliflora*.

Capsule densely white-villous; stigma sessile.

9. *S. argophylla*.

IV. CORDATAE.

Capsule long-stipitate; stipe in fruit 1.5-6 mm. long, equalling or longer than the bracts; style 0.5 mm. or less long; aments leafy-peduncled.

Leaves dark green above, strongly serrate; young branches not light yellow.

10. *S. cordata*.

Leaves yellowish green, entire or crenulate; young branches light yellow.

11. *S. Watsoni*.

Capsule subsessile or very short-stipitate; stipe in fruit less than 1.5 mm. long and much shorter than the bracts; style 0.5-1.5 mm. long; aments subsessile and naked or subtended by a few small leaves.

Branches without a bloom.

Leaves lanceolate to ovate or obovate, more or less distinctly serrate.

Leaves thin, ovate or obovate, light green and dull above.

12. *S. padophylla*.

Leaves firm, dark-green and shining above, lanceolate.

Style 1.5 mm. long; aments 2.5-6 cm. long. 13. *S. pseudocordata*.

Style less than 1 mm. long; aments 1-2.5 cm. long.

14. *S. monticola*.

Leaves linear-lanceolate to oblong, entire.

15. *S. Wolfii*.

Branches with a bloom.

16. *S. irrorata*.

V. ROSTRATAE.

Leaves linear to lanceolate or oblanceolate.

Leaves more or less silky; branches usually with a bloom.

17. *S. Geyeriana*.

Leaves not silky; branches without a bloom.

18. *S. macrocarpa*.

Leaves ovate to obovate.

Mature leaves thin, glabrous, faintly nerved.

19. *S. perrostrata*.

Mature leaves firm, pubescent or tomentose beneath, more strongly nerved.

20. *S. Bebbiana*.

VI. BRACHYSTACHYAE.

Only represented by

21. *S. Nuttallii*.

VII. PELLITAE.

Only represented by

22. *S. pachnophora*.

VIII. ARCTICAE.

Leaves grayish-villous on both sides, although less so above.

Twigs white-villous; branches yellow or grayish. 23. *S. brachycarpa*.

Twigs puberulent, rarely villous; branches usually purplish.

Leaf-blades oblong or linear-oblong; bracts obovate; shrub depressed.

24. *S. pseudolapponum*.

Leaf-blades oblanceolate or obovate-oblanceolate; bracts oblong; shrub not depressed.

25. *S. glaucops*.

Leaves glabrate or when young covered with white hairs parallel to the midrib.

Shrubs not creeping; leaf-blades oval to oblong or lanceolate.

Aments leafy-peduncled.

25. *S. glaucops glabrata*.

Aments subsessile, naked from lateral buds.

26. *S. chlorophylla*.

Shrubs creeping; leaf-blades obovate to oblanceolate.

27. *S. petrophila*.

IX. RETICULATAE.

Only represented by

28. *S. saximontana*.

1. *Salix Wrightii* Anders. Along streams from Tex. to Colo. and Calif.—Alt. 4000-5500 ft.—Arkansas River; Denver.

2. *Salix amygdaloides* Anders. Along streams from Que. to Wash., N. Y., Mo. and Ariz.—Alt. 4000-7000 ft.—Plains, Colorado Springs; Denver; Wal-

senburg; Cucharas river, below La Veta; mesas near Pueblo; Fort Collins; near Boulder; gulch west of Pennock's mountain ranch; Trinidad; La Porte.

3. *Salix Fendleriana* Anders. (*S. pentandra caudata* Nutt.; *S. lasiandra Fendleriana* Bebb.) Wet mountain valleys and along streams from Alb. to B. C., N. M. and Calif.—Alt. 7000-10,000 ft.—New Windsor; Gunnison; on Turkey Creek and tributaries; Los Pinos; along the Uncompahgre River, near Ouray; Ojo; Mancos; Cimarron; Fort Collins; along the Conejos River, north of Antonito; Trail Creek; Steamboat Springs.

4. *Salix exigua* Nutt. On river-banks from Mackenzie River to Wash., Colo. and Calif.—Alt. 5000-10,000 ft.—Plains, Colorado Springs; Twin Lakes; North Park; Los Pinos; Trinidad.

5. *Salix lutesericea* Rydb. On sandy river-bars from Neb. to Mont., Ida. and Colo.—Alt. 4000-6000 ft.—Fort Collins; plains, Larimer Co.; Walsenburg; Sterling, Logan Co.; near Boulder; Elizabethtown; Denver; Walton Creek; along the Conejos River, north of Antonito; Rist Cañon; Dolores.

6. *Salix stenophylla* Rydb. Along streams from Tex. to Colo. and N. M.—Alt. 4000-8000 ft.—Mancos; Cucharas River, below La Veta; Walsenburg; Gunnison; Cerro Summit.

7. *Salix linearifolia* Rydb. (*S. longifolia tenerrima* Henders.) Along streams from Minn. and Sask. to Wash., Ark. and Colo.—Exact locality not given.

8. *Salix sessiliflora* Nutt. Along streams from Alb. to Mont., Colo. and Nev.—Alt. 4000-8000 ft.—Grand Cañon; along Uncompahgre River, near Ouray; Grand Junction; Cerro Summit.

9. *Salix argophylla* Nutt. Along streams from Mont. to Wash., Tex. and Calif.—Alt. about 5000 ft.—Fort Collins; Rist Cañon.

10. *Salix cordata angustata* (Pursh) Anders. In river-valleys from N. B. to Wash., Va. and N. M.—Alt. 4000-10,000 ft.—Los Pinos; Walsenburg; Cucharas River, below La Veta; on Turkey Creek and tributaries.

11. *Salix Watsoni* (Bebb.) Rydb. (*S. cordata Watsoni* Bebb.; *S. flava* Rydb.; not Schoepf.) In river-valleys from Mont. to Calif. and Colo.—Alt. 6000-7000 ft.—Manitou; South Park; Middle Park; Walsenburg; Cucharas Valley, near La Veta.

12. *Salix padophylla* Rydb. In valleys from Mont. to N. M.—Alt. 8000-11,000 ft.—Los Pinos; Pass Creek; Ojo; Bob Creek, West La Plata Mountains; North Park; on Turkey Creek and tributaries; Gunnison; Carson; Silverton; near Chambers' Lake; Dolores.

13. *Salix pseudocordata* Anders. (*S. Novae-Angliae pseudocordata* Anders.) Along streams from Sask. to Alb. and Colo.—Alt. 6000-7000 ft.—Manitou; North Park; South Cheyenne Cañon.

14. *Salix monticola* Bebb. In mountain valleys from Alb. to Ore., Colo. and Nev.—Alt. 2200-3000 ft.—Pike's Peak; Lake City; Georgetown; headwaters of Sangre de Cristo Creek; North Cheyenne Cañon; Chamber's Lake; Sheep Creek, above Campton's.

15. *Salix Wolfii* Bebb. In mountain valleys of Wyoming and Colo.—Alt. 8000-10,500 ft.—South Park; Tennessee Pass; on Grizzly Creek; Iron-ton Park, nine miles south of Ouray; North Park; Rico; Eldora to Baltimore; Camp Creek, Larimer Co.

16. *Salix irrorata* Anders. In cañons and along streams from Colo. to N. M.—Alt. 6000-9000 ft.—Dry rocks, Cheyenne Mountain; Manitou; Cucharas Valley, near La Veta; South Cheyenne Cañon; foot-hills, Larimer Co.; Los Pinos; Iron-ton Park, nine miles south of Ouray; Gunnison; Crested Butte, Gunnison watershed; Grizzly Creek; Sheep Creek, above Campton's; Horsetooth Gulch; Rist Cañon; Howe's Gulch.

17. *Salix Geyeriana* Anders. In mountain valleys along streams from Wyo. to Wash., Colo. and Ore.—Alt. 8000-10,000 ft.—Mountains of Estes Park; Minturn; Columbine; Sargent's; Pinkham Creek, Larimer Co.

18. *Salix macrocarpa* Nutt. Along streams in the mountains from Wyo. to Wash. and Colo.—Alt. up to 10,000 ft.—Seven Lakes; Stove Prairie, Larimer Co.

19. *Salix perrostrata* Rydb. In valleys and in wet places in the foot-hills from Hudson Bay to Alaska and Colo.—Alt. 1500-2700 ft.—Foot-hills, Colorado Springs; foot-hills west of Fort Collins; Los Pinos; South Cheyenne Cañon; Ruxton; Green Mountain Falls; Ojo; Cimarron; Chicken Creek, West La Plata Mountains; Pike's Peak Trail; Rist Cañon; mountains north-east of Dolores; Boulder.

20. *Salix Bebbiana* Sarg. (*S. rostrata* Richardson) In valleys and on hillsides from Anticosti to Alaska, N. J. and Calif.—Alt. 5000-10,000 ft.—Manitou; Ruxton Dell; Pike's Peak; North Park, Larimer Co.; mountains of Estes Park, Larimer Co.; Horsetooth Gulch; Boulder; Beaver Creek.

21. *Salix Nuttallii* Sarg. (*S. flavescens* Nutt.) Along streams and in wet valleys from Ass. and B. C. to N. M. and Calif.—Alt. 7000-11,000 ft.—Hills about Box Cañon, west of Ouray; Wahatoya Cañon; Little Kate Basin, La Plata Mountains; mountains, Larimer Co.; Artists' Glen; North Cheyenne Cañon; chaparral-covered hills southeast of Ouray; Stove Prairie, Larimer Co.; Mount Baldy; Barnes' Camp on Little South; Redstone; Eldora to Baltimore; Empire.

22. *Salix pachnophora* Rydb. In the mountains along streams, Colo. and N. M.—Alt. 7000-8000 ft.—Rico, Dolores Co.; along Uncompahgre River; near Ouray; Chambers' Lake; Hahn's Peak, Routt Co.; Rabbit-Ears.

23. *Salix brachycarpa* Nutt. (*Salix desertorum stricta* Anderson; *S. stricta* Rydb.) In springy places in the mountains from Que. to Alb. and Colo.—Alt. 7000-11,000 ft.—Twin Lakes; Pike's Peak; Sheep Creek, above Campton's; near Higo; Veta Pass, Sangre de Cristo Range; Walden, Larimer Co.

24. *Salix pseudolapponum* Seem. On mountain tops of Colorado.—Alt. 9000-13,000 ft.—Gray's Peak; Georgetown; Cimarron Pass; Alpine Tunnel; Mt. Abram, Ouray; Sierra Blanca; Little Kate Basin, La Plata Mountains; Mt. Hesperus, above timber line; West Spanish Peak; headwaters of Sangre de Cristo Creek; Twin Lakes; Bottomless Pit; east slope Pike's Peak; Dead Lake; Tennessee Pass; bank of Michigan, North Park; mountains above Graymont; Eldora to Baltimore; Berthoud Pass.

25. *Salix glaucope* Anders. In alpine bogs and springy places from Alb. to Yukon Terr., Colo. and Calif.—Alt. 7000-13,000 ft.—In var. *glabrata* Anders., the leaves are nearly glabrous above.—Mountains between Sunshine and Ward; Brush Creek, Custer Co.; mountains south of Ward, Boulder Co.; Bear Creek Divide, West La Plata Mountains; Alpine Tunnel; Mt. Abram,

Ouray; Sheep Creek, above Campton's; Sierra Blanca; near Pagosa Peak; Silver Plume; timber line, Pike's Peak; Iron-ton Park, nine miles south of Ouray; Mt. Harvard; Red Mountain, south of Ouray; Marshall's Pass; Carson; Lake Moraine; mountains above Boreas; head of Red River, Franklin; Hematite; Cameron Pass; southeast of Jefferson; Empire.

26. *Salix chlorophylla* Anders. In mountain bogs from Lab. to Alaska, N. H. and Colo.—Alt. 8000–12,000 ft.—Georgetown; Clear Creek, Middle Park; Alpine Tunnel; mountains above Boreas; Pike's Peak; Little Kate Basin; Wahatoya Cañon; Buffalo Pass, Park Range; Red Mountain, south of Ouray; Columbine; mountains of Estes Park, Larimer Co.; Carson; Marshall Pass; mountains above Boreas; Cameron Pass; Rabbit-Ears, Larimer Co.; Beaver Creek; North Park Range, Routt Co.

27. *Salix petrophila* Rydb. (*S. arctica petraea* Anderson) On exposed mountain tops from N. H. to B. C., Colo. and Utah.—Alt. 12,000–14,000 ft.—Gray's Peak; near Pagosa Peak; mountains above Boreas; Mt. Howard; Marshall Pass.

28. *Salix saximontana* Rydb. (*S. reticulata* Port. & Coult., in part) On exposed mountain tops from Wyo. to Colo. and Nev.—Alt. 9000–14,000 ft.—Clear Creek, Middle Park; Arapahoe Peak; Argentine Pass; Floral Mountain; Georgetown; Mt. Hesperus; mountains above Cameron Pass; Gray's Peak; Bald Mountain; West Spanish Peak; Mount Garfield; Sierra Blanca; Alpine Tunnel; Franklin; Ragged Mountain, Gunnison Co.; Ethel Peak, Larimer Co.

Order 20. FAGALES.

Staminate and pistillate flowers both in aments; fruit not with a bur or cup.

Staminate flowers 2 or 3 together in the axils of the bracts, each with a calyx; pistillate flowers without a calyx. 36. BETULACEAE.

Staminate flowers solitary in the axils of each bract without a calyx; pistillate flowers with a calyx. 37. CORYLACEAE.

Staminate flowers in aments; pistillate often solitary, the involucre becoming a cup or bur. 38. FAGACEAE.

Family 36. BETULACEAE Agardh. BIRCH FAMILY.

Stamens 2; bracts of the mature pistillate aments membranous, usually 3-lobed, deciduous with the nut. 1. BETULA.

Stamens usually 4 (3–6); bracts of the mature pistillate aments thickened and woody, erose or toothed, persistent. 2. ALNUS.

1. BETULA L. BIRCH.

Wings of the fruit much wider than the body; trees or tall shrubs.

1. *B. fontinalis*.

Wing of the fruit usually narrower than the body; low shrubs. 2. *B. glandulosa*.

1. *Betula fontinalis* Sarg. (*B. occidentalis* S. Wats.; not Hook.) Along streams from S. D. and Alb. to Yukon Terr., N. M. and Ore.—Alt. 5000–9000 ft.—Walsenburg; Garland; Engelmann Cañon; foot-hills, Fort Collins; Livermore, Larimer Co.; South Cheyenne Cañon; North Cheyenne Cañon; Ojo; Pass Creek; foot-hills near Fort Collins; Elizabethtown; Howe's Gulch; west of Rist Cañon; Rist Cañon; Eldora to Baltimore; Elk River, Routt Co.

2. *Betula glandulosa* Michx. In bogs from Greenl. to Alaska, N. H., Colo. and Ore.—Alt. 9000–11,000 ft.—Middle Park; Argentine Pass; Cameron Pass; mountains above Como; Twin Lakes; Seven Lakes; Blue River; Iron-ton Park, nine miles south of Ouray; Ruxton Park; head of Muddy River, Middle Park; Pike's Peak; Tennessee Pass; Silverton; Breckenridge; between Como and Boreas; bank of the Big Muddy; western Gunnison Co.; Eldora to Baltimore.

2. **ALNUS** Gaertn. ALDER.

1. *Alnus tenuifolia* Nutt. (*A. incana virescens* S. Wats.) Along streams from Mont. to Alaska, N. M. and Calif.—Alt. 6000–10,000 ft.—Mountains between Sunshine and Ward; Ojo; Turkey Creek and tributaries; cañon, Idaho Springs; Cucharas Valley, near La Veta; Hermosa; near Pagosa Peak; headwaters of Pass Creek; Larimer Co.; Bob Creek, West La Plata Mountains; Red Mountain, south of Ouray; Lower Boulder Cañon, Boulder Co.; Parlin; Colorado Springs; Black Cañon of the Gunnison; Rist Cañon; foot-hills near Fort Collins; Steamboat Springs; Dolores.

Family 37. **CORYLACEAE** Mirbel. HAZEL-NUT FAMILY.

1. **CORYLUS** L. HAZEL-NUT.

1. *Corylus rostrata* Ait. In thickets and open woods and on hillsides from N. S. to N. D., Ga. and Colo.—Alt. 1200–8000 ft.—Lower Boulder Cañon, Boulder Co.; North Cheyenne Cañon; foot-hills, Larimer Co.; Rist Cañon; gulch west of Soldier Cañon; vicinity of Arthur's Rock.

Family 38. **FAGACEAE** Drude. BEECH FAMILY.

1. **QUERCUS** L. OAK.

Leaves lobed or divided, not evergreen; lobes rounded, obtuse or acute, but not spinulose-tipped.

Leaves bright green, early deciduous.

Mature leaves softly pubescent, almost velvety beneath, deeply divided.

1. *Q. utahensis*.

Mature leaves glabrate, puberulent or somewhat pubescent, but not velvety beneath.

Cup flat, covering less than $\frac{1}{4}$ of the acorn.

2. *Q. Vreelandii*.

Cup hemispheric, covering $\frac{1}{2}$ to $\frac{3}{4}$ of the acorn.

Acorns barrel-shaped, obtuse.

Mature leaves very thin, glabrate beneath or puberulent only on the veins; cup covering about $\frac{1}{2}$ of the acorn; scales of cup thin.

3. *Q. leptophylla*.

Mature leaves firm, puberulent beneath, cup covering about $\frac{1}{3}$ of the acorn; scales of cup thick, corky.

Leaves mostly oblong in outline, lobed halfway to the midrib or less, rather dull.

4. *Q. Gunnisonii*.

Leaves obovate in outline, divided deeper than halfway to the midrib, very shining above.

Lobes of the leaves broadly oblong, rounded at the apex.

5. *Q. nitescens*.

Lobes of the leaves ovate or triangular, acute.

6. *Q. novomexicana*.

Acorns ovoid, acute; cup covering about $\frac{1}{2}$ of the acorn.

7. *Q. Gambellii*.

Leaves pale green, more persistent.

Lobes oblong-ovate, obtuse or acutish, not mucronate.

8. *Q. venustula*.

Lobes triangular-ovate, mucronate.

9. *Q. Fendleri*.

Leaves persistent, evergreen, sinuate; lobes or teeth spinulose-tipped or mucronate.

Leaves decidedly crisped, sinuately lobed; lobes distinctly spinulose-tipped.

10. *Q. pungens*.

Leaves flat, sinuately toothed; teeth mucronate or slightly spinulose-tipped.

11. *Q. undulata*.

1. *Quercus utahensis* (A. DC.) Rydb. (*Q. stellata Utahensis* A. DC.) A small tree, often 10 feet or more high, growing in the mountain regions of Utah, Colo., Ariz. and N. M.—Alt. 4000–9000 ft.—Chaparral-covered hills southeast of Ouray; Hotchkiss, Delta Co.; Trinidad; Glenwood Springs; Mancos; North Cheyenne Cañon; Wahatoya Cañon; hills about Box Cañon, west of Ouray; Manitou; Mancos Cañon; west of Palmer Lake; Glen Eyrie.

2. *Quercus Vreelandii* Rydb. A chaparral-forming shrub, 1–1.5 m. high, growing on hillsides in Colo. and N. M.—Alt. 4000–9000 ft.—Chaparral-covered hills southeast of Ouray; Cerro; Glenwood Springs; butte five miles southwest of La Veta; South Cheyenne Cañon; Colorado Springs.

3. *Quercus leptophylla* Rydb. A tree, 10–15 m. high, growing along streams in the mountains of Colorado.—Alt. 5500–8500 ft.—Turkey Creek and tributaries; Cucharas River, above La Veta; North Cheyenne Cañon; Routt Co.; Chicken Creek, West La Plata Mountains.

4. *Quercus Gunnisonii* (Torr.) Rydb. A chaparral-forming shrub, 1–3 m. high, growing on hillsides and mesas from Colo. to Utah, N. M. and Ariz.—Alt. 6000–8000 ft.—North Cheyenne Cañon; butte five miles southwest of La Veta; Colorado Springs; Cochetopa Pass; Cañon of Arkansas; Cañon City; Durango; hills back of Manitou; Steamboat Springs; Denver.

5. *Quercus nitescens* Rydb. A chaparral-forming shrub, 3–5 m. high, growing on mesas and hillsides, but along streams sometimes forming a small tree; in Colo. and eastern Utah.—Alt. 6000–11,000 ft.—Butte five miles southwest of La Veta; Glenwood Springs; chaparral-covered hills southeast of Ouray; Red Mountain, south of Ouray; hills about Box Cañon, west of Ouray; West Mancos Cañon; Four-Mile Hill, Routt Co.; Los Pinos; Ute Pass, near Pike's Peak; Cheyenne Cañon, near Pike's Peak.

6. *Quercus novomexicana* (A. DC.) Rydb. (*Q. Douglasii Novomexicana* A. DC.) A chaparral-forming shrub, 3–5 m. high, or along streams a small tree, from Colo. to Utah and N. M.—Alt. 4000–9000 ft.—Glenwood Springs; Engelmann Cañon; between Pallas and Sydney; Cucharas River, above La Veta; Mancos; Manitou; chaparral-covered hills southeast of Ouray; Cheyenne Mountain; Cañon City.

7. *Quercus Gambellii* Nutt. A chaparral-forming shrub, 3–5 m. high, growing on hillsides from Colo. to Utah and N. M.—Alt. 6500–9000 ft.—Chaparral-covered hills southeast of Ouray; Cucharas River, above La Veta; Gunnison; Twelve-Mile Creek; north of Cheyenne Cañon; Manitou; Cañon of the Arkansas; South Park; Ute Pass; Garden of the Gods.

8. *Quercus venustula* Greene. A small shrub, 1–2 m. high, known only from the type locality.—Raton Mountains, near Trinidad.

9. *Quercus Fendleri* Liebm. A shrub, 1-3 m. high, growing on dry hillsides from Colo. to Tex. and Ariz.—Alt. 5000-7000 ft.—Mesas near Colorado Springs; McElmo Cañon; Raton Mountains, near Trinidad; Cañon of Arkansas; Green Horn Mountains; Poncho Pass; Purgatory River, near Trinidad.

10. *Quercus pungens* Liebm. (*Q. undulata Wrightii* Engelm.) A low shrub, 1-3 m. high, on dry hills from Colo. to Utah, Tex. and Ariz.; also Mex.—Cañon City; Arkansas Cañon.

11. *Quercus undulata* Torr. (*Q. undulata Jamesii* Engelm.) A shrub, 1-3 m. high, growing on dry hills from Colo. to Tex. and Ariz.—“Rocky Mountains”; Cañon of the Arkansas; Steamboat Springs.

Order 21. URTICALES.

Style and stigma 1; ovules erect or ascending; herbs with small greenish flowers; fruit an achene.

39. URTICACEAE.

Styles and stigmas 2; ovules pendulous.

Herbs or herbacious vines with opposite leaves; fruit an achene.

40. CANNABINACEAE.

Trees or shrubs with alternate leaves; fruit a samara or drupe.

41. ULMACEAE.

Family 39. URTICACEAE Reichenb. NETTLE FAMILY.

Herbs with stinging hairs; leaves opposite; flowers not involucre.

1. URTICA.

Herbs without stinging hairs; leaves alternate; flowers involucre by leafy bracts.

2. PARIETARIA.

1. URTICA L. NETTLE.

Teeth of the leaves ovate, strongly directed forward; stem sparingly strigose and bristly.

1. *U. gracilis*.

Teeth of the leaves broadly triangular, not strongly directed forward; stem glabrous or nearly so.

2. *U. gracilentia*.

1. *Urtica gracilis* Ait. In alluvial soil along streams from N. S. to Alaska, N. C. and N. M.—Alt. 4000-9000 ft.—Mountains between Sunshine and Ward; Steamboat Springs; Mancos; Bob Creek, West La Plata Mountains; Fort Collins; along the Uncompahgre River, near Ouray; chaparral-covered hills southeast of Ouray; Gunnison; Spring Cañon; Campton's ranch.

2. *Urtica gracilentia* Greene. (*U. Breweri* Coulter; not S. Wats.) Along streams from Wyo. to Tex. and N. M.—Alt. up to 9000 ft.—Near Pagosa Peak.

2. PARIETARIA L. PELLITORY.

Leaf-blades lanceolate, 2-7 cm. long, twice as long as the petioles or longer.

1. *P. pennsylvanica*.

Leaf-blades oblong or ovate-oblong, 0.5-2 cm. long, not twice as long as the petioles.

2. *P. obtusa*.

1. *Parietaria pennsylvanica* Muhl. On shaded banks and hillsides from Ont. to B. C., Fla. and Mex.—Alt. 4000-7000 ft.—Steamboat Springs; Lower Boulder Cañon, Boulder Co.; Black Cañon; foot-hills, Larimer Co.; gulch west of Pennock's mountain ranch; along Poudre River, near Fort Collins; Horsetooth Gulch.

2. *Parietaria obtusa* Rydb. In shaded places from Colo. to Utah, Tex. and Calif.—Alt. up to 6000 ft.—El Paso; Sunset Cañon.

Family 40. **CANNABINACEAE** Lindl. HEMP FAMILY.

1. **HUMULUS** L. HOPS.

1. *Humulus lupulus neo-mexicanus* Cockerell. The native hops of the Rocky Mountain region has deeper divided leaves and more sharply acuminate bracts than the cultivated variety. It grows along streams from Wyo. to Utah, N. M. and Ariz.—Alt. 5000-8000 ft.—Fort Collins; Colorado Springs; along the Uncompahgre River, near Ouray; Parlin, Gunnison Co.; Walsenburg; Manitou; cañon west of Palmer Lake; along Cache la Poudre River; Poudre Cañon.

Family 41. **ULMACEAE** Mirbel. ELM FAMILY.

1. **CELTIS** L. HACKBERRY.

1. *Celtis reticulata* Torr. (*C. occidentalis* Port. & Coult.; not L.) On hillsides, in rocky places, from Tex. to Colo. and Ariz.—Alt. 4000-6000 ft.—“Colorado,” locality not given; plains and foot-hills near Boulder; near Osborne City; Golden; gulch west of Pennock’s mountain ranch; foot-hills 6-8 miles west of Fort Collins.

Order 22. **SANTALALES.**

Leaves opposite: fruit a berry; tree-parasites.

42. **LORANTHACEAE.**

Leaves alternate: fruit a drupe or nut; root-parasites or saprophytes.

43. **SANTALACEAE.**

Family 42. **LORANTHACEAE** D. Don. MISTLETOE FAMILY.

Anthers 2-celled; pollen-grains smooth; berry globose, pulpy and semi-translucent.

1. **PHORADENDRON.**

Anthers 1-celled; pollen spinulose; berry compressed, fleshy, opaque.

2. **RAZOUMOFSKYA.**

1. **PHORADENDRON** Nutt.

1. *Phoradendron juniperinum* Engelm. Parasitic on species of *Sabina* from Colo. and Ore. to Tex. and Calif.; also in Mex.—Mancos; Hotchkiss; Paxton ranch.

2. **RAZOUMOFSKYA** Hoffm.

Staminate flowers all or nearly all terminal on distinct peduncles, dichotomously paniculate (on *Pinus Murrayana*, *contorta* and *divaricata*). 1. *R. americana*. Staminate flowers nearly all axillary, forming simple or compound spikes.

Branches 1-2 mm. in diameter.

Plant yellowish-green; accessory branches of fruiting specimens flower-bearing.

Spikes short, 3-5-flowered; stems bluntly angled (on *Pseudotsuga mucronata*).

2. *R. Douglasii*.

Spikes many-flowered; stems sharply angled (on *Pinus flexilis*).

3. *R. cyanocarpa*.

LORANTHACEAE.

Plant greenish-brown; accessory branches merely leaf-bearing (on *Caryopitys edulis* and *monophylla*).

Branches 3-4 mm. in diameter (on *Pinus scopulorum*, and *ponderosa*).

4. *R. divaricata*.

5. *R. cryptopoda*.

1. *Razoumofskya americana* (Nutt.) Kuntze. (*Arceuthobium Americanum* Nutt.) Parasitic on *Pinus Murrayana*, *contorta* and *divaricata*, from Sask. and B. C. to Colo. and Ore.—Dillon; Grand Lake; Sunset.

2. *Razoumofskya Douglasii* (Engelm.) Kuntze. (*A. Douglasii* Engelm.) Parasitic on *Pseudotsuga*, from Ida. to N. M.—South Cheyenne Cañon; El Paso Co.; West Mancos Cañon.

3. *Razoumofskya cyanocarpa* A. Nels. Parasitic on *Pinus flexilis*, from Wyo. to Colo.—Cheyenne Mountain.

4. *Razoumofskya divaricata* (Engelm.) Kuntze. (*A. divaricatum* Engelm.) Parasitic on *Caryopitys edulis* and *monophylla*.—Mancos; Dillon.

5. *Razoumofskya cryptopoda* (Engelm.) Coville. (*Arceuthobium cryptopodum* Engelm.; *A. robustum* Engelm.) Parasitic on *Pinus scopulorum* and *ponderosa*.—Between Sunshine and Ward, Boulder Co.; West Indian Creek; Custer Co.; Stove Prairie Hill; Rist Cañon.

Family 43. **SANTALACEAE** R. Br. SANDAL-WOOD FAMILY.

1. **COMANDRA** Nutt. BASTARD TOAD-FLAX.

1. *Comandra pallida* A. DC. On plains and hills from Man., Alb. and B. C. to N. M. and Utah.—Alt. 4000-8000 ft.—Van Boxle's ranch, above Cimarron; Cucharas River, below La Veta; Wahatoya Creek; Los Pinos; Steamboat Springs; Mancos; Fort Collins; Boulder; Dolores; along Poudre River; Horsetooth Gulch; Colorado City; Pinkham Creek, Larimer Co.

Order 23. **POLYGONALES.**

Family 44. **POLYGONACEAE** Lindl. BUCKWHEAT FAMILY.

Flowers subtended by involucre; stamens 9.

1. **ERIOGONUM.**

Flowers not involucre; stamens 4-8.

Stigmas tufted.

Perianth 6-parted; styles 3-parted; achenes 3-angled.

2. **RUMEX.**

Perianth 4-parted; style 2-parted; achenes lenticular.

3. **OXYRIA.**

Stigmas capitate.

Leaf-blades jointed at the base; ochreae 2-lobed, becoming lacerate; filaments at least the inner dilated.

4. **POLYGONUM.**

Leaf-blades not jointed at the base; ochreae not 2-lobed; filaments slender.

Ochreae cylindric, truncate.

5. **PERSICARIA.**

Ochreae oblique, more or less open on the side facing the leaf.

6. **BISTORTA.**

Simple strict herbs with terminal spikes; perianth-lobes not keeled.

7. **TINIARIA.**

Twining vines with flowers in axillary clusters; outer perianth-lobes winged or keeled.

1. **ERIOGONUM** L.

Achenes 3-winged; perianth not accrescent.

I. **ALATA.**

Achenes merely 3-angled; perianth accrescent in fruit.

Perianth with a stipe-like base.

Involucre in branching cymes.

II. **ERIANTHA.**

Involucres in simple or compound umbel-like or head-like clusters.

Perianths hairy.

III. FLAVA.

Perianth glabrous.

IV. UMBELLATA.

Perianth without a stipe-like base.

Ovaries and fruit pubescent; involucres few, capitate or subcymose.

V. LACHNOGYNA.

Ovaries and fruit glabrous or nearly so.

Involucres in head-like or umbel-like clusters.

Perianth-lobes very unequal.

VI. HETEROSEPALA.

Perianth-lobes equal or nearly so.

VII. CAPITATA.

Involucres in open cymes.

Cymes 1-sided and spike-like.

X. VIRGATA.

Cymes dichotomous or trichotomous.

Bracts scale-like.

Involucres, except those in the forks of the inflorescence, sessile in the bractlets; the uppermost conglomerate.

Perennial with a suffruticose caudex or shrubby.

VIII. CORYMBOSA.

Annuals, erect and strict.

IX. ANNUA.

Involucres all peduncled, never conglomerate.

XI. PEDUNCULATA.

Bracts leaf-like.

Primary cauline leaves scale-like, with a pair or a fascicle of well-developed secondary leaves in their axils.

XII. DIVARICATA.

Primary cauline leaves well developed, often also with secondary leaves in their axils.

XIII. FOLIOSA.

I. ALATA.

Involucres hairy, when mature 3-3.5 mm. long and 1.5-2 mm. wide; stem and leaves manifestly hairy.

1. *E. alatum*.

Involucres glabrous, when mature 2-2.5 mm. long and of the same width; stem and leaves nearly glabrous.

2. *E. triste*.

II. ERIANTHA.

Perianth whitish; styles hairy at least to the middle.

3. *E. Jamesii*.

Perianth yellow; styles hairy only at the base.

Involucres 6-8 mm. long; leaf-blades oblong to oblanceolate.

4. *E. Bakeri*.

Involucres 9-10 mm. long; leaf-blades suborbicular to oval.

5. *E. arcuatum*.

III. FLAVA.

Stipe-like base of the perianth very short; old leaf-bases permanently tomentose.

Leaf-bases thickened; perianth copiously white-pubescent; leaf-blades silky above; involucres usually several.

6. *E. flavum*.

Leaf-bases not thickened; perianth sparingly pubescent; leaf-blades slightly floccose above; involucres 1-3.

7. *E. aureum*.

Stipe-like base of the perianth slender; old leaf-bases glabrous.

8. *E. xanthum*.

IV. UMBELLATA.

Perianth deep yellow.

Umbels simple.

Leaves densely tomentose beneath.

9. *E. umbellatum*.

Leaves almost glabrous at maturity.

10. *E. umbelliferum*.

Umbels compound; leaves tomentose beneath.

11. *E. croceum*.

Perianth cream-color.

Perianth about 6 mm. long at maturity; leaf-blades spatulate-oblong or elliptic, glabrous above at maturity.

12. *E. subalpinum*.

Perianth about 8 mm. long at maturity; leaf-blades oval or ovate, permanently tomentose above.

13. *E. latum*.

V. LACHNOGYNA.

Leaves and scape silky; the latter elongated, 1 dm. or more high; the former 2-4 cm. long, long-petioled; blades oblanceolate to oblong, acute.

Inflorescence irregularly branched.

14. *E. lachnogynum*.

Inflorescence subcapitate.

15. *E. tetraeuris*.

Leaves lanate, strongly revolute; scape usually none.

16. *E. acaule*.

VI. HETEROSEPALA.

Involucres about 7 mm. long; leaf-blades oval.

17. *E. orthocaulum*.

Involucres 4-5 mm. long.

Perianth bright yellow, or purplish; leaf-blades about as broad as long.

18. *E. ovalifolium*.

Perianth cream-colored to isabel-colored; leaf-blades elliptic to oval or spatulate, decidedly longer than broad.

19. *E. ochroleucum*.

VII. CAPITATA.

Perianth yellow.

20. *E. chrysocephalum*

Perianth white or brownish or pinkish.

Perianth pubescent.

21. *E. multiceps*.

Perianth glabrous.

Lobes of the involucres much shorter than the tube.

22. *E. coloradense*.

Lobes of the involucres about as long as the tube.

23. *E. pauciflorum*.

VIII. CORYMBOSA.

Perianth yellow.

Leaves crowded on the short branches of the caudex; blades oblong to linear-oblong, flat.

24. *E. campanulatum*.

Leaves more scattered on the elongated branches of the caudex; blades narrowly linear, strongly revolute.

25. *E. brevicaulis*.

Perianth white or pinkish.

Shrubs or herbaceous plants with a woody caudex, mostly over 2 dm. high; leaves not heath-like.

Flowering branches leafy only at the base.

Involucres in the forks of the inflorescence sessile.

Leaves mostly flat; involucres narrowly turbinate; perianth 2-2.5 mm. long.

26. *E. lonchophyllum*.

Leaves mostly revolute; involucres campanulate; perianth 3-3.5 mm. long.

27. *E. nudicaule*.

Involucres in the forks of the inflorescence distinctly peduncled, at least the lower.

Involucres broadly campanulate, about as wide as long.

28. *E. scoparium*.

Involucres turbinate, decidedly longer than broad.

Leaves narrowly linear-oblanceolate or linear, usually revolute.

29. *E. tristichum*.

Leaves spatulate to oblanceolate, flat.

30. *E. salicinum*.

Flowering branches leafy halfway or more.

Leaf-blades relatively broad, broadly oblong to oval, obtuse.

Involucres 4-5 mm. long.

31. *E. Fendlerianum*.

Involucres 2-2.5 mm. long.

Branches of inflorescence divaricate.

32. *E. divergens*.

Branches of inflorescence ascending.

33. *E. corymbosum*.

Leaf-blades narrow, from spatulate to linear, acute.

Leaf-blades spatulate or oblanceolate, mostly flat.

Inflorescence many times compound, copiously branched; internodes long.

Inflorescence tomentulose, broom-like, with strongly ascending branches; involucres about 1.5 mm. long.

34. *E. effusum*.

- Inflorescence glabrous, lax with spreading branches; involucre 2-2.5 mm. long. 30. *E. salicinum*.
 Inflorescence less compound; branches and internodes short, mostly spreading. 35. *E. microthecum*.
 Leaf-blades linear, revolute. 36. *E. Simpsonii*.
 Dwarf depressed undershrubs, less than 1 dm. high, with heath-like leaves. 37. *E. contortum*.

IX. ANNUA.

One species.

38. *E. annuum*.

X. VIRGATA.

- Leaves crowded on the ends of the short caudex; blades abruptly narrowed at the base or subcordate. 39. *E. racemosum*.
 Leaves scattered on the fruticose branches; blades tapering at the base. 40. *E. Wrightii*.

XI. PEDUNCULATA.

Perianth glabrous.

Scapes and branches glabrous.

Peduncles erect or ascending.

Perianth-lobes nearly equal and similar; leaves glabrous.

41. *E. Gordonii*.

Perianth-lobes very unequal and dissimilar; leaves floccose beneath.

Outer perianth-lobes dilated above; involucre about 1.5 mm. long.

42. *E. rotundifolium*.

Outer perianth-lobes not dilated above; involucre about 3 mm. long.

43. *E. tenellum*.

Peduncles reflexed or deflexed.

44. *E. cernuum*.

Scapes and branches villous or glandular, especially near the nodes.

45. *E. trinervatum*.

Perianth glandular or pubescent.

Scapes and branches glandular, especially near the nodes, not inflated.

48. *E. glandulosum*.

Scapes and branches glabrous; upper portion of the lower internodes of the scape inflated.

Accessory branches at the lower forks of the inflorescence many and nearly as strong as the three main branches; branches divaricate.

46. *E. fusiforme*.

Accessory branches at the lower forks of the inflorescence none or few and small; branches ascending.

47. *E. inflatum*.

XII. DIVARICATA.

One species.

49. *E. divaricatum*.

XIII. FOLIOSA.

One species.

50. *E. salsuginosum*.

1. *Eriogonum alatum* Torr. In sandy soil from Neb. and Wyo. to Tex. and Ariz.—Alt. 4000-10,000 ft.—Headwaters of Clear Creek and alpine ridges east of Middle Park; plains and foot-hills near Boulder; Green Mountain Falls; Sand Creek Pass; South Park; Williams' Cañon, near Pike's Peak; Sangre de Cristo Creek; Table Rock; Pagosa Springs; Thompson's Park, La Plata Mountains; Spring Cañon; Dillon Cañon, near Trinidad; plains, near foot-hills, Larimer Co.

2. *Eriogonum triste* S. Wats. (*E. alatum glabriusculum* Torr.) In sandy soil from Colo. to Tex. and N. M.—North Park; headwaters of Clear Creek and alpine ridges east of Middle Park.

3. *Eriogonum Jamesii* Benth. On plains and hills from Kans. and Colo. to Tex. and Ariz.—Alt. 4000-9000 ft.—Headwaters of Platte River; Colorado

Springs; Durango; Middle Park; La Veta; Grand Junction; Morrison; Gunnison; Salida; Sangre de Cristo Creek; Red Rock Cañon, near Pike's Peak; Rosita; Buena Vista.

4. *Eriogonum Bakeri* Greene. (*E. flavum vegetius* T. & G.; *E. Jamesii flavescens* S. Wats.; *E. vegetius* (T. & G.) Nels.) On plains and hills from Wyo. and Utah to N. M. and Ariz.—Alt. 9000–10,000 ft.—Meadow Park; mountains between Sunshine and Ward; Bald Mountain, west of Loveland; Black Cañon; Horsetooth Gulch, Fort Collins; Poudre Cañon; Moon's ranch.

5. *Eriogonum arcuatum* Greene. Mountains in Colo.—Alt. about 7000 ft.; known only from the type locality.—Pagosa Springs.

6. *Eriogonum flavum* Nutt. (*E. crassifolium* Dougl.) On dry hills and mountains and in cañons from Sask. and Alb. to Neb. and Colo.—Alt. 4000–12,000 ft.—Headwaters of Clear Creek and alpine ridges east of Middle Park; plains and foot-hills near Boulder; Sand Creek Pass; Twin Lakes; Medicine Bow Mountains; Minnehaha; Ruxton; Georgetown; Fossil Creek; Artists' Glen and Cheyenne Cañon, near Pike's Peak.

7. *Eriogonum aureum* Nutt. (*E. chloranthum* Greene.) Mountains of Colo.—Alt. 11,000–13,000 ft.—Mount Ouray; Marshall Pass.

8. *Eriogonum xanthum* Small. On exposed mountain tops in Colorado.—Alt. 12,000–14,000 ft.—Gray's Peak; spur of Mt. Harvard.

9. *Eriogonum umbellatum* Torr. On mountains and dry valleys in Wyo., Ida., Colo. and Utah.—Alt. 6000–12,000 ft.—Headwaters of Clear Creek and alpine ridges east of Middle Park; North Park; Arkansas Junction, near Leadville; plains and foot-hills near Boulder; mountains between Sunshine and Ward; Gunnison; Fort Collins; Clear Creek Cañon; near Denver; Mancos; South Table Mountain, Golden; cañons and meadows, Ouray; Kelso Mountain; Horsetooth Gulch; Colorado and Wyoming State line; near Narrows; hills west of Soldier Cañon; camp on Grizzly Creek, foot of Rabbit-Ear Range; Empire.

10. *Eriogonum umbelliferum* Small. Mountains from Wyo. and Nev. to Colo. and Utah.—Alt. 7000–11,000 ft.—Veta Pass; Grayback mining camps; vicinity of Ouray; Redcliffe, Eagle Co.; Van Boxle's ranch, above Cimarron; Black Cañon; headwaters of Sangre de Cristo Creek; Glenwood Springs; Leroux Creek, Delta Co.; Lake Creek; Middle Park; Spicer, Larimer Co.

11. *Eriogonum croceum* Small. Mountains from Ida. and Wash. to Colo.—Alt. up to 9000 ft.—Hesperus; Telluride; Piedra.

12. *Eriogonum subalpinum* Greene. In dry mountain valleys from Alb. and B. C. to Colo. and Nev.—Alt. 5000–10,000 ft.—Headwaters of Arkansas River; Larimer Co.; near Pinkhampton, North Park; Arkansas Junction, near Leadville; edge of Wyoming, North Park; Crested Butte; Dillon; Idaho Springs; South Park; Middle Park; foot of Mt. Richtofen, on the Michigan; north bank of Poudre River; forks of Poudre and Big South; Rustic; Empire; Pinkham Creek.

13. *Eriogonum latum* Small. In dry valleys and on plains from Mont. and Wash. to Colo. and Utah.—Alt. about 5000 ft.—Denver.

14. *Eriogonum lachnogymum* Torr. Dry plains and cañons from Kans. and Colo. to Tex. and N. M.—Alt. about 5000 ft.—Brantly Cañon, Las Animas Co.

15. *Eriogonum Tetraneuris* Small. Dry mesas of Colorado.—Alt. about 5000 ft.—Bank of the Cimarron River; mesas near Pueblo.
16. *Eriogonum acaule* Nutt. On dry hills from Wyo. and Ida. to Colo.—“Southwest Colorado.”
17. *Eriogonum orthocaulum* Small. Dry plains and hills from Alb. and Ida. to Colo. and Nev.—Rifle, Garfield Co.
18. *Eriogonum ovalifolium* Nutt. Dry plains and hills from Mont. and Wash. to N. M. and Calif.—Alt. 6000–7000 ft.—Mancos; Grand Junction.
19. *Eriogonum ochroleucum* Small. Dry rocky hills from Mont. and Ida. to Colo. and Nev.—Grand Junction.
20. *Eriogonum chrysocephalum* A. Gray. (*E. Kingii laxifolium* T. & G.; *E. laxifolium* A. Nels.) Dry hills and plains of Neb., Wyo., Colo. and Utah.—“Southern Colorado” (*Brandegee*).
21. *Eriogonum multiceps* Nees. Dry plains and “bad-lands” from N. D. and Mont. to Neb. and Colo.—Exact locality not given.
22. *Eriogonum coloradense* Small. Mountain in Colo.—Mt. Harvard.
23. *Eriogonum pauciflorum* Pursh. In sandy soil in Wyo. and Colo.—Alt. up to 9000 ft.—Middle Park; in low sandy valleys, North Park; North Fork, Larimer Co.
24. *Eriogonum campanulatum* Nutt. Dry hills and plains from Neb. and Wyo. to Colo. and Utah.—“Colorado” (*Parry*); Middle Park.
25. *Eriogonum brevicaule* Nutt. On dry plains from Mont. to Colo. and Utah.—Egeria Park; Elk River, Routt Co.
26. *Eriogonum lonchophyllum* T. & G. On plains of N. M. and Colo.—Durango.
27. *Eriogonum nudicaule* (Torr.) Small. (*E. effusum nudicaule* Torr.) Plains from Kans. and Utah to Tex.—Alt. about 7500 ft.—Cimarron.
28. *Eriogonum scoparium* Small. Plains of Colo. and N. M.—Alt. 5000–8000 ft.—Vicinity of Gunnison; Denver; Durango; between Porter and Durango.
29. *Eriogonum tristichum* Small. Plains of Colo.—Alt. 5000–9000 ft.—Parlin, Gunnison Co.; Mesa Verde; Arboles; Black Cañon, Gunnison; Durango.
30. *Eriogonum salicinum* Greene. Cañon in Colo.—Alt. about 7000 ft.; known only from type locality.—Black Cañons, near Gunnison.
31. *Eriogonum Fendlerianum* (Benth.) Small. (*E. microthecum Fendlerianum* Benth.) Dry plains of Colo. and N. M.—Alt. about 5000 ft.—Cañon City; Pueblo.
32. *Eriogonum divergens* Small. (*E. corymbosum divaricatum* Torr.; not *E. divaricatum* Hook.) Dry plains from Colo. to Utah and Ariz.—Green River.
33. *Eriogonum corymbosum* Benth. Dry plains of Colo.—Alt. 5000–7000 ft.—Along San Juan River; Grand River; Mancos.
34. *Eriogonum effusum* Nutt. Dry plains from Mont. to Neb. and Colo.—Alt. 4000–8000 ft.—Wahatoya Creek; Denver; Cañon City; vicinity of Boulder; Morrison; Golden; Buena Vista; Manitou; New Windsor, Weld Co.; mesas, Cucharas Valley, near La Veta; Fort Collins; headwaters of Clear Creek and alpine ridges east of Middle Park; Salida; Fort Collins; Table Rock; La Veta.

35. *Eriogonum microthecum* Nutt. Dry plains from Mont. and Wash. to Colo. and Calif.—Colorado City; Beaver Creek.

36. *Eriogonum Simpsonii* Benth. Dry plains from Colo. to Tex. and Ariz.—San Luis Valley; Rio Florido.

37. *Eriogonum contortum* Small. Arid plains of western Colo.—Grand Junction.

38. *Eriogonum annuum* Nutt. In sandy soil from S. D. and Mont. to Tex. and Mex.—Alt. 4000-7500 ft.—Piney Creek of Grand River; Denver; Manitou; Ute Pass; Colorado Springs; Golden; Table Rock.

39. *Eriogonum racemosum* Nutt. Dry plains and hills from Colo. and Utah to Tex. and Ariz.—Alt. 6000-8000 ft.—Between Parrott and Hesperus; Jack's Cabin; Gunnison; hills about Box Cañon, west of Ouray; Dolores; Piedra; between Porter and Durango; Mancos; Durango.

40. *Eriogonum Wrightii* Torr. Dry plains from Colo. and Utah to Tex. and Calif.; also northern Mex.—"Colorado" (*Thurber*).

41. *Eriogonum Gordonii* Benth. Dry plains and "bad-lands" of Wyo. and Colo.—Cañon City; Gunnison Valley; mesa, Montrose; Grand Junction.

42. *Eriogonum rotundifolium* Benth. Dry plains from Colo. to Tex. and N. M.; also in northern Mex.—"Near the Rocky Mountains."

43. *Eriogonum tenellum* Torr. In arid places from Colo. to Tex. and Mex.—"Southwest Colorado."

44. *Eriogonum cernuum* Nutt. "Bad-lands," hills and in cañons from Mont. and Ida. to Colo. and Ariz.—Alt. 4000-10,000 ft.—Cañon City; South Park; along the McElmo River; Grand Junction; along Platte River, near Denver; Parlin, Gunnison Co.; Valley Spur; Granite; Buena Vista; Gunnison; Minnehaha; Black Cañon of the Gunnison; Troublesome; Upper Arkansas River; Bahia Salada, South Park; Sierra Blanca; Sargent's.

45. *Eriogonum trinervatum* Small. Arid places of Colo. and Utah.—Alt. 4000-7000 ft.—Cimarron; Grand Junction.

46. *Eriogonum fusiforme* Small. In sandy places and dry hills from Colo. to Utah and Ariz.—Alt. 4000-5000 ft.—Grand Junction; Palisade, Mesa Co.; dry adobe hills, between Delta and Hotchkiss.

47. *Eriogonum inflatum* Torr. In arid places from Colo. to Ariz. and Cal.—Alt. 4000-5000 ft.—On the Upper Colorado; Grand Junction.

48. *Eriogonum glandulosum* Nutt. (*E. flexum* Jones.) Arid places of Colo.—Alt. about 6000 ft.—McElmo Cañon; Grand Junction.

49. *Eriogonum divaricatum* Hook. Dry hills from Wyo. to Colo. and Ariz.—San Juan and Mancos Valleys (*Brandegee*).

50. *Eriogonum salsuginosus* Hook. In dry alkaline soil from Wyo. to Utah and N. M.—Alt. 4000-6000 ft.—Near the Mancos River; Grand Junction; McElmo Cañon; San Juan Valley.

2. RUMEX L. SORREL, DOCK.

Flowers dioecious; foliage acid.

Leaves with auricled or hastate bases.

Leaves narrowed at the base, neither auricled nor hastate.

1. *R. Acetosella*.

2. *R. pauciflorus*.

Flowers perfect, or andro-polygamous; foliage not acid.

Inner perianth-lobes entire, undulate or denticulate.

Inner perianth-lobes without tubercles.

Inner perianth-lobes in fruit over 2 cm. broad, plants with deep-seated woody rootstock. 3. *R. venosus*.

Inner perianth-lobes in fruit less than 1.5 cm. in diameter.

Plants with clusters of tuberous roots; inner perianth-lobes in fruit 1-1.5 cm. broad.

Achene about 7 mm. long; inner perianth-lobes in fruit broader than long; plant low. 4. *R. salinus*.

Achenes about 5 mm. long; inner perianth-lobes in fruit longer than broad. 5. *R. hymenosepalus*.

Plants with taproots or thickened rootstocks; inner perianth-lobes in fruit 5-10 mm. wide.

Plants low, less than 3 dm. high, with short tuber-like rootstock; fruit maturing before the inner perianth-lobes become enlarged.

6. *R. praecox*.

Plant tall, not with a tuber-like rootstock; inner perianth-lobes well enlarged in fruit.

Inner perianth-lobes in fruit with rounded apex, not conspicuously punctate. 7. *R. occidentalis*.

Inner perianth-lobes abruptly pointed, conspicuously punctate.

Fruiting inner perianth-lobes broader than long, sinuate on the margin. 8. *R. densiflorus*.

Fruiting inner perianth-lobes longer than broad, sharply dentate.

9. *R. subalpinus*.

Inner perianth-lobes or at least one of them bearing a tubercle in fruit.

Only one tubercled.

Leaves dark green, more or less crisp; fruiting inner perianth-lobes 8-9 mm. broad, reniform. 10. *R. Patientia*.

Leaves pale green, not crisp; fruiting inner perianth-lobes 5-6 mm. broad, deltoid ovate. 11. *R. altissimus*.

All three petals bearing tubercles.

Leaves wavy-margined, dark green, not glaucescent.

12. *R. crispus*.

Leaves flat, light green and glaucescent.

13. *R. salicifolius*.

Inner perianth-lobes in fruit spinulose on the margin.

Tall plants; lower leaf-blades cordate at the base; one tubercle.

14. *R. obtusifolius*.

Low plants; lower leaf-blades narrowed at the base; 3 tubercles.

15. *R. persicarioides*.

1. *Rumex Aetosella* L. In waste places, old fields, roadsides, etc., from Lab. and Alaska to Fla. and Calif.; introduced from Europe.—Alt. about 5000 ft.—Boulder.

2. *Rumex pauciflorus* Nutt. (*R. Geyeri* (Meisn.) Trelease.) In meadows from Mont. and Wash. to Colo. and Calif.—Continental Divide, Larimer Co.; Steamboat Springs; Rabbit-Ears.

3. *Rumex venosus* Pursh. In sandy soil from Ass. and Wash. to Kans. and Nev.—Alt. 4000-8000 ft.—Cucharas River, below La Veta; Fort Collins; Pleasant Valley; upper part of Platte; Miller's ranch; Bingham Hill; Pueblo; Wray; Colorado Springs.

4. *Rumex salinus* A. Nels. In sandy soil in Wyo. and Colo.—Palisades.

5. *Rumex hymenosepalus* Torr. In sandy soil from Ind. Terr. and Utah to Tex. and Calif.—Alt. 4000-9000 ft.—Grayback mining camps; Grand Junction.

6. *Rumex praecox* Rydb. Along brooks in the higher mountains of Wyo. and Colo.—Alt. 8000-10,000 ft.—Grayback mining camps; Bob Creek, west La Plata Mountains.

7. *Rumex occidentalis* S. Wats. In wet ground from Alb. and B. C. to N. M. and Calif.—Alt. 5000-8000 ft.—West Cliff; Hot Sulphur Springs; Steamboat Springs; Veta Pass; Mountain View, Pike's Peak; Gunnison; Idaho Springs; Pine Creek; Twin Lakes; Parlin, Gunnison Co.; forks of White River.

8. *Rumex densiflorus* Osterh. (*R. Bakeri* Greene.) In wet ground in Wyo. and Colo.—Alt. up to 10,000 ft.—Idaho Springs; North Park; Gunnison; Fort Collins; summit of North Park Range, Routt Co.

9. *Rumex subalpinus* M. E. Jones. In swampy ground in the mountains of Colo. and Utah.—Alt. about 10,000 ft.—Keblar Pass; Pagosa Peak; Cameron Pass; North Park; Deadman Cañon.

10. *Rumex Patientia* L. Cultivated and occasionally escaped from Mass. and N. J. to Utah; native of Europe.—Pass Creek; Little Kate Basin (?).

11. *Rumex altissimus* Wood. In valleys and wet places from Mass. and Wash. to Va. and Colo.—Mouth of Deer Creek.

12. *Rumex crispus* L. In waste places from Newf. and Mont. to Fla. and Calif.; introduced from Europe.—Alt. about 5000 ft.—Fort Collins.

13. *Rumex salicifolius* Weim. Along rivers and lakes from Ont. and Alaska to Tex. and Calif.; also in Mex.—Alt. 4000-10,000 ft.—Zola; Sangre de Cristo Creek; Calhan; Fort Collins; Cucharas Valley, near La Veta; La Plata; Boulder; New Windsor; Robinson; Alamosa; Pitkin; Empire; Pueblo; Steamboat Springs.

14. *Rumex obtusifolius* L. In waste places from Vt. and Neb. to Ga. and Colo.; introduced from Europe.—Alt. about 5000 ft.—Fort Collins.

15. *Rumex persicarioides* L. (*R. maritimus* L.) In or near water from Que. and B. C. to N. C. and Calif.—Parlin; Gunnison; Cañon City; Highgo; New Windsor; Steamboat Springs; above Bents' Fort.

3. OXYRIA Hill. MOUNTAIN SORREL.

1. *Oxyria digyna* (L.) Compt. In the mountains among rocks from Greenl. and Alaska to N. H., Colo., Ariz. and Calif.; also in Europe and Asia.—Alt. 9000-14,000 ft.—Cameron Pass; headwaters of Clear Creek; Ouray; Bottomless Pit, Pike's Peak; Mt. Harvard; Red Mountain, south of Ouray; Redcliffe; Ironton; Clear Lake; Pagosa Peak; Mt. Hesperus; Chambers' Lake; Berthoud Pass; Beaver Creek; Graymont; Hahn's Peak.

4. POLYGONUM L. KNOT-WEED.

Fruit erect.

Inflorescence of small axillary clusters, scattered more or less throughout the plant; all with elongated stems or branches; perianth-lobes never keeled near the apex.

Plants copiously leafy throughout; upper leaves scarcely reduced, more crowded.

Perianth-lobes with yellowish green margins; plant erect with spreading branches in age, leaves broad, yellowish green. 1. *P. erectum*.

Perianth-lobes with white, pink or purplish margins; plants prostrate or diffusely spreading; leaves from bright to pale bluish green.

Leaves thick, prominently veined, usually pale; ocrea very conspicuous; faces of the achenes granular. 2. *P. buxiforme*.

Leaves thin, not prominently veined, bright green; ocrea not conspicuous; faces of the achenes finely striate. 3. *P. aviculare*.

Plants with the upper leaves more scattered and reduced, mostly erect perennials.

Upper bracts not subulate; achenes dull.

Lobes of the perianth with yellowish margins; perianth 3-4 mm. long; achenes about 3 mm., nearly smooth. 4. *P. ramosissimum*.

Lobes of the perianth with whitish or pinkish margins; perianth 2-3 mm. long; achenes 2-2.5 mm. long, distinctly granulate or striate.

5. *P. rubescens*.

Upper bracts subulate; achenes smooth and shiny.

6. *P. sawatchense*.

Inflorescence aggregated at the ends of the branches; bracts leaf-like and usually broader than the narrowly linear leaves; plants dwarf annuals.

None of the perianth-lobes keeled.

Leaves several, gradually merging into the bracts; achenes blunt-angled and strongly striate. 7. *P. Watsonii*.

Leaf usually solitary and much longer than the bracts; achenes sharp-angled and obscurely striate. 8. *P. unifolium*.

Some of the perianth-lobes keeled near the apex. 9. *P. Kelloggii*.

Fruit reflexed.

Upper bracts much reduced and subulate.

Perianth 1.5-2 mm. long; leaves narrowly linear; achenes exerted.

10. *P. Engelmannii*.

Perianth 4-5 mm. long; lower leaves oblanceolate to linear-oblanceolate; achenes included. 11. *P. Douglasii*.

Upper bracts foliaceous, relatively broad, lanceolate or oblong.

Achenes included. 12. *P. montanum*.

Achenes exerted. 13. *P. commixtum*.

1. *Polygonum erectum* L. In waste places from Me. and Alb. to Ga. and Ark. and Kans. Also reported from Colorado, but no exact locality given.

2. *Polygonum buxiforme* Small. (*P. litorale* Small, in part) In sandy and alkaline soil from Ont. and Wash. to Va., Tex. and Nev.—Alt. 4000-10,000 ft.—Georgetown; Silver Plume; along Platte River, Denver; Montrose; Fort Collins; Colorado Springs.

3. *Polygonum aviculare* L. In waste grounds from Newf. and Sask. to Va. and Calif.; introduced from Europe.—Alt. 4000-8000 ft.—Fort Collins; Gunnison.

4. *Polygonum ramosissimum* Michx. In river valleys and low ground from Minn. and Wash. to Ills., N. M. and Nev.—Alt. 4000-10,000 ft.—Cheyenne Mountain; Fort Collins; Upper La Plata Cañon.

5. *Polygonum rubescens* Small. In sandy soil from Ida. to Colo. and Utah.—Alt. 4500-8000 ft.—Parlin, Gunnison Co.; Larimer Co.

6. *Polygonum sawatchense* Small. On hillsides from S. D. and Wash. to Colo., Ariz. and Calif.—Alt. 4000-9000 ft.—Saguache Range; Box Cañon, west of Ouray; Calhan; Veta Pass; Estes Park.

7. *Polygonum Watsonii* Small. (*Polygonum imbricatum* S. Wats.) In wet places from Mont. and Wash. to Colo. and Calif.—Alt. 6000-10,000 ft.—South Park; Leroux Park; Upper West Mancos Cañon; Chambers' Lake.

8. *Polygonum unifolium* Small. In wet places from Mont. to Colo.—Tennessee Pass.

9. *Polygonum Kelloggii* Greene. In wet soil from Wash. and Mont. to Calif.—Alt. 6000-10,000 ft.—Steamboat Springs; Bard Creek Valley, near Empire.

10. *Polygonum Engelmannii* Greene. (*P. tenue microspermum* Engelm.) On hillsides and mountains from Mont. and B. C. to Colo.—Alt. 5000-10,000

ft.—Georgetown; Golden; Bergen Park; Idaho Springs; Boulder; Manitou; Dale Creek; Lower Boulder Cañon.

11. *Polygonum Douglasii* Greene. (*P. tenue* Coulter; not Michx.) On hillsides and in sandy soil from Vt. and B. C. to N. Y., N. M. and Calif.—Alt. 4000–10,000 ft.—Larimer Co.; Brantly Cañon, Las Animas Co.; Pagosa Springs; Wahatoya Creek; cañons west of Ouray (broad-leaved form); Sheepshorn Divide, Middle Park; Pagosa Peak (broad-leaved); Eagle River; Boulder; Soldier Cañon; Big Creek Gulch; Walton Creek; Arthur's Rock; Bosworth ranch; Horsetooth Gulch; Chambers' Lake; Boulder; Golden; Idaho Springs.

A form more branched at the base is *Polygonum Douglasii consimile* (Greene) Small. (*P. consimile* Greene)—Lower Boulder Cañon.

12. *Polygonum montanum* (Small) Greene. (*P. tenue latifolium* Engelm.) In the mountains from Alb. to Colo. and Calif.—Alt. 8000–12,000 ft.—Marshall Pass; Red Mountain; Ironton Park; North Park; Mt. Harvard; Silver Plume; White River Plateau.

13. *Polygonum commixtum* Greene. In the mountains from Colo. to Mont.—Alt. 8000–12,000 ft.—Silver Plume; Grizzly Creek; Cameron Pass; Mt. Robinson; summit of mountains west of North Park.

5. *PERSICARIA* Adans. SMART-WEED, LADY'S THUMB.

Racemes terminal only and usually solitary; plants aquatic.

Ocrea without a spreading foliaceous top.

Plant usually floating; leaf-blades of an oblong type, glabrous, acute or obtuse.

1. *P. coccinea*.

Plant usually diffuse and emersed; leaf-blades of a lanceolate type, pubescent, acuminate.

2. *P. Muhlenbergii*.

Ocrea with a spreading foliaceous top; leaf-blades narrowly oblong or lanceolate (broader in floating forms), pubescent.

3. *P. Hartwrightii*.

Racemes axillary as well as terminal, numerous.

Ocrea without marginal bristles.

Racemes erect; glands on the branches and inflorescence numerous, stalked.

4. *P. omissa*.

Racemes drooping; glands on the branches and inflorescence sessile.

Styles united only at the base.

5. *P. incarnata*.

Styles united to about the middle.

Leaves deep green on both sides.

6. *P. lapathifolia*.

Leaves pale beneath.

7. *P. incana*.

Ocrea bristle-fringed.

Racemes oblong or cylindric, densely flowered, about 1 cm. thick in fruit; perianth not punctate, usually pink to red-purple.

8. *P. Persicaria*.

Racemes slender, loosely flowered, about 5 mm. thick in fruit; perianth white or pale-green, copiously punctate.

Racemes erect; achenes smooth and shining.

9. *P. punctata*.

Racemes nodding, at least in fruit; achenes granular and dull.

10. *P. Hydropiper*.

1. *Persicaria coccinea* (Muhl.) Greene. (*Polygonum amphibium* Hook.; not L.; *P. coccineum* Muhl.) In water or rarely in mud from Me. and Alaska to N. J. and Calif.—Alt. up to 9000 ft.—West Cliff, Pike's Peak; McCoy; Ouray; Veta Mountain; Hamor's Lake; Gunnison.

2. *Persicaria Muhlenbergii* (S. Wats.) Small. (*Polygonum Muhlenbergii* S. Wats.) In swamps, mud and shallow water from Me. and B. C. to Va.

and Calif.; also in Mex.—Alt. up to 6000 ft.—Uncompahgre Mountains, near Los Pinos; Fort Collins; Alamosa.

3. *Persicaria Hartwrightii* (A. Gray) Small. (*Polygonum Hartwrightii* A. Gray.) In wet places and shallow water from Me. and Wash. to Pa. and Calif.—Alt. 4000–6000 ft.—Cañon City; Denver.

4. *Persicaria omissa* (Greene) Small. (*Polygonum Pennsylvanicum* Coult.; not L.; *P. omissum* Greene.) In wet ground and dried up ponds in Kans. and Colo.—Alt. up to 5000 ft.—Loveland, Larimer Co.

5. *Persicaria incarnata* (Ell.) Small. (*Polygonum incarnatum* Ell.) In wet soil from Vt. and Ida. to Fla. and Calif.—Alt. up to 5000 ft.—Fort Collins; New Windsor.

6. *Persicaria lapathifolia* (L.) S. F. Gray. (*Polygonum lapathifolium* L.) In wet soil from Que. and B. C. to Fla. and Calif.; also in Mex., W. Ind., Europe and Asia.—Alt. up to 5000 ft.—Fort Collins.

7. *Persicaria incana* (Koch) S. F. Gray. (*Polygonum lapathifolium incanum* Koch.) In swamps from Newf. and B. C. to N. Y. and Colo.—Alt. up to 6000 ft.—Alamosa.

8. *Persicaria Persicaria* (L.) Small. (*Polygonum Persicaria* L.) In waste places and rich ground from Newf. and B. C. to Fla. and Calif.; also in Mex. and Europe.—Alt. 4000–6000 ft.—Boulder; Livermore; Fort Collins.

9. *Persicaria punctata* (Ell.) Small. (*Polygonum punctatum* Ell.) In swamps and wet places from Me. and Wash. to Fla. and Calif.; also in Mex., Cent. Am., W. Ind. and S. Am.—Alt. up to 5000 ft.—Fort Collins; plains near Boulder.

10. *Persicaria Hydropiper* (L.) Opiz. (*Polygonum Hydropiper* L.) In wet places from Newf. and B. C. to Ga. and Calif.; also in Mex., Cent. Am. and Europe.—Alt. 4000–5000 ft.—Fort Collins; Denver.

6. BISTORTA Tourn. BISTORT.

Racemes not viviparous (not bulblet bearing), oblong, 1–2 cm. thick.

Perianth 5–6 mm. long; leaf-blades lanceolate, oblong or oblanceolate.

1. *B. bistortoides*.

Perianth 3–4 mm. long; basal leaf-blades linear.

2. *B. linearifolia*.

Racemes viviparous (bulblet bearing below), linear, 5–8 mm. thick.

3. *B. vivipara*.

1. *Bistorta bistortoides* (Pursh) Small. (*Polygonum Bistorta oblongifolium* Meisn.) In wet meadows and swamps in the mountains from Mont. and Wash. to N. M. and Calif.—Alt. 7000–13,000 ft.—“Rocky Mountains”; Lake City; Halfway House, Pike’s Peak; Cabin Cañon; Mt. Harvard; Columbine; South Park; Mt. Garfield; Pagosa Peak; Grayback mining camps and Placer Gulch; Garden of the Gods; Ruxton; Cameron Pass; Graymont; Chicken Creek, West La Plata Mountains; Marshall Pass; Oak Mesa; Beaver Creek, Larimer Co.; Boreas; Gore Pass.

2. *Bistorta linearifolia* (S. Wats.) Greene. (*Polygonum Bistorta linearifolium* S. Wats.) In alpine swamps and along streams from Mont. to Colo. and Nev.—Alt. 7000–10,000 ft.—Alpine ridges east of Middle Park; “Rocky Mountains”; Pike’s Peak.

3. *Bistorta vivipara* (L.) S. F. Gray. (*P. viviparum* L.) In alpine or sub-

arctic swamps from Greenl. and Alaska to N. H. and Colo.; also Europe and Asia.—Alt. 8000–12,000 ft.—Alpine Tunnel; Grand Lake; Robinson; Seven Lakes; Little Kate Basin, La Plata Mountains; West Spanish Peak; Cameron Pass; Indian Creek Pass; White River Plateau; Gray's Peak; North Park; Eldora to Baltimore; Beaver Creek; Cameron Pass; Gore Pass; Graymont.

7. **TINIARIA** Reichenb. FALSE BUCKWHEAT.

Outer sepals merely keeled at maturity.

T. Convolvulus.

Outer sepals developing conspicuous wings.

T. scandens.

1. *Tiniaria Convolvulus* (L.) Webb. & Moq. (*Polygonum Convolvulus* L.) Among bushes from N. S. and B. C. to Fla. and Calif.—Alt. 4000–9000 ft.—Box Cañon, west of Ouray; Engelmann Cañon; Fort Collins; Colorado Springs.

2. *Tiniaria scandens* (L.) Small. (*Polygonum scandens* L.) In thickets from N. S. to Mont., Fla., La. and Colo.—Exact locality not given.

Order 24. **CHENOPODIALES.**

Fruit a utricle, achene or anthocarp, indehiscent, circumscissile or bursting irregularly.

Fruit a utricle.

Stipules wanting.

Bracts not scarious.

Bracts scarious.

Stipules present, scarious.

Fruit an anthocarp, the achene surrounded by the tube of the corolla-like calyx.

45. CHENOPODIACEAE.

46. AMARANTHACEAE.

47. CORRIGIOLACEAE.

48. ALLIONIACEAE.

Fruit a capsule, dehiscent by apical or longitudinal valves.

Ovary several-celled; corolla wanting.

Ovary 1-celled; corolla mostly present.

Sepals, 2; or, if more (in *Lewisia*), plant scapose, with fleshy basal leaves and the flowers solitary on a jointed scape.

Sepals, 4–5; plants leafy-stemmed.

Sepals distinct; petals not clawed; ovary sessile.

Sepals united; petals clawed; ovary more or less distinctly stipitate.

49. TETRAGONIACEAE.

50. PORTULACACEAE.

51. ALSINACEAE.

52. CARYOPHYLLACEAE.

Family 45. **CHENOPODIACEAE** Dumort. GOOSEFOOT FAMILY.

Embryo annular.

Stems and branches not jointed; leaves not scale-like.

Flowers perfect, all with perianth, not inclosed in a pair of bracts.

Fruit inclosed in the calyx.

Calyx in fruit not transversely winged.

Sepals 3–5, stamens 1–5.

Fruiting calyx herbaceous.

Fruiting calyx fleshy, red.

Sepals 1; stamens 1.

Calyx in fruit transversely winged.

Flowers paniculate; leaves ample, sinuate, flat.

Flowers spicate; leaves linear, terete.

Fruit laterally flattened, exserted from the marcescent calyx.

1. CHENOPODIUM.

2. BLITUM.

4. MONOLEPIS.

3. CYCLOLOMA.

9. KOCHIA.

10. CORIOSPERMUM.

Flowers monoecious or dioecious; the pistillate inclosed in two accrescent bractlets.

Pericarp not hairy.

Bracts compressed, *i. e.*, with one side towards the axis; leaves more or less farinose; testa mostly coriaceous. 5. *ATRIPLEX*.

Bracts ob-compressed, *i. e.*, with one edge towards the axis; testa membranous.

Pericarp hastate with crested margins, 2-toothed apex; more or less farinaceous herbs with toothed leaves. 6. *SUCKLEYA*.

Pericarp obovate or orbicular, entire; undershrubs with entire leaves. 7. *GRAYIA*.

Pericarp densely hairy, conical; low and tomentose shrubs. 8. *EUROTIA*.

Stems and branches fleshy, jointed; leaves scale-like. 11. *SALICORNIA*.

Embryo spirally coiled.

Shrubs with monoecious bractless flowers; staminate flowers in spikes, without perianth; pistillate ones solitary, axillary; fruiting calyx transversely winged. 12. *SARCOBATUS*.

Herbs with perfect bracteolate flowers.

Fruiting calyx transversely winged; leaves spiny. 14. *SALSOLA*.

Fruiting calyx not winged; leaves fleshy, not spiny. 13. *DONDIA*.

1. *CHENOPODIUM* L. GOOSEFOOT, LAMB'S QUARTERS, PIG-WEED.

Leaves more or less mealy or glabrate, never glandular or sweet-scented, sinuately lobed, dentate or entire; embryo forming a complete ring.

Stamens 5; calyx not at all fleshy in fruit.

Leaves entire or sinuately toothed, but not with large, divaricate teeth; seeds 1-1.5 mm. in diameter.

Calyx lobes carinate; at least the upper panicles exceeding the leaves.

Pericarp easily separating from the seeds.

Leaves linear or oblong, entire or slightly sinuately toothed.

Leaves thin, linear; inflorescence not very dense; spikes somewhat interrupted below. 1. *C. leptophyllum*.

Leaves thick, oblong; inflorescence dense and crowded.

Plant densely mealy, yellowish.

Plant tall with nearly erect branches. 2. *C. oblongifolium*.

Plant low with spreading-ascending branches.

3. *C. desiccatum*.

Plant only slightly mealy, dark green.

4. *C. Wolfii*.

Leaves broadly ovate or triangular, more or less hastate at the base.

Plant densely mealy; leaves rather thick.

Plant low and spreading.

5. *C. incanum*.

Plant tall and erect.

6. *C. albescens*.

Plant sparingly mealy; leaves very thin.

7. *C. Fremontii*.

Pericarp firmly attached to the seed.

Leaves subentire or merely hastately toothed.

Leaves thick, more or less mealy; none of them cuspidate.

8. *C. Watsonii*.

Leaves thin, glabrate, all or the upper usually cuspidate.

9. *C. Berlandieri*.

Leaves more or less sinuately dentate; inflorescence dense.

10. *C. album*.

Calyx lobes not carinate; panicles mostly axillary, shorter than the leaves.

11. *C. glaucum*.

Leaves with large divergent acute lobes; seeds about 2 mm. in diameter.

12. *C. hybridum*.

Stamens 1-2; calyx reddish and slightly fleshy in fruit.

Plant usually over 1 dm. high, erect; leaves usually more or less toothed.

13. *C. rubrum*.

Plant less than 1 dm. high, prostrate; leaves entire or merely hastately toothed.

Leaves glandular, sweet-scented, pinnately lobed; embryo horseshoe-shaped.

Lobes of the leaves rounded or broadly oblong, more or less toothed.

Lobes of the leaves lanceolate, entire.

14. *C. humile*.

15. *C. Botrys*.

16. *C. cornutum*.

1. *Chenopodium leptophyllum* Nutt. On prairies, in waste places and fields from Neb. to Mont., Mo. and Ariz.—Alt. 4000-8000 ft.—Gunnison; Buena Vista; Deer Run, Gunnison watershed; entrance to Grand Cañon, 15 miles from Grand Junction.

2. *Chenopodium oblongifolium* (S. Wats.) Rydb. (*C. leptophyllum oblongifolium* S. Wats.) On dry prairies and plains from N. D. to Wyo., Mo., Tex. and Ariz.—Atl. 4000-7000 ft.—Crow Creek; foot-hills, Larimer Co.; Fort Collins; Wray.

3. *Chenopodium desiccatum* Aven Nelson. Dry waste places in Colo.—Fort Collins.

4. *Chenopodium Wolfii* Rydb. In dry places in the mountains of Wyo. and Colo.—Alt. 7000-10,000 ft.—Twin Lakes; Cheyenne Mountain; Crow Creek; Grizzly Creek; Parlin, Gunnison Co.; Steamboat Springs.

5. *Chenopodium incanum* (S. Wats.) Heller. (*C. Fremontii incanum* S. Wats.) In dry grounds, especially in prairie dog towns.—Alt. 4000-5000 ft.—Crow Creek; Fort Collins.

6. *Chenopodium albescens* Small. In dry soil from Tex. to Colo.—Durango.

7. *Chenopodium Fremontii* S. Wats. Among bushes and in cañons from S. D. to Mont., N. M. and Ariz.; also in Mex.—Alt. 4000-9000 ft.—Vicinity of Fort Collins; Sangre de Cristo Creek; Minnehaha; southeast of Ouray; Poudre Cañon.

8. *Chenopodium Watsonii* A. Nelson. (*C. olidum* S. Wats.) In dry places from Colo. to Ariz.—Alt. up to 10,000 ft.—Valley Spur.

9. *Chenopodium Berlandieri* Moq. In dry soil from Mo. to Wyo., Fla. and Tex.—Alt. 4000-9000 ft.—Sheepshorn Divide, North Park; near Pagosa Peak; Huerfano Valley.

10. *Chenopodium album* L. In fields and waste places; introduced and naturalized from Europe; from Newf. to Alb., Fla. and Calif.—Gunnison; about Fort Collins.

11. *Chenopodium glaucum* L. In alkaline soil from Alb. to Colo. and Utah; also in Europe.—Alt. 4000-8000 ft.—Walsenburg; Steamboat Springs; New Windsor; Gunnison; La Veta; above Palisade.

12. *Chenopodium hybridum* L. In waste places and around dwellings from Que. to B. C., N. Y. and Utah.—Alt. 4000-8000 ft.—Park Range; Steamboat Springs; Mancos; Hotchkiss, Larimer Co.; Johnston Cañon; Gunnison; Horsetooth Gulch; gulch west of Soldier Cañon; Big Creek Gulch.

13. *Chenopodium rubrum* (L.) Reichenb. In alkaline flats and meadows from N. Y. to Alb., Mo. and Colo.—Alt. 4000-8000 ft.—Hot Springs in San Luis Valley; Mt. Harvard; Gunnison; West Cliff; Delta; north of Trapper's Lake; falls of the Poudre.

14. *Chenopodium humile* Hook. In alkaline meadows from Mont. to B. C., Neb. and Colo.—Alt. up to 8000 ft.—Gunnison.

15. *Chenopodium Botrys* L. In waste places from N. S. to B. C., Ga. and Calif.; also Mex.—Alt. 4000–8000 ft.—Plains and foot-hills near Boulder; Ouray; Idaho Springs; Box Cañon, west of Ouray; Clear Creek Cañon, above Golden.

16. *Chenopodium cornutum* B. & H. In dry places from Colo. to N. M. and Ariz.; also in Mex.—Alt. 4000–8000 ft.—Huerfano Co.; Buena Vista; Little Veta Mountain.

2. BLITUM L. STRAWBERRY BLITE.

Leaves more or less dentate, truncate or broadly cuneate at the base; inflorescence dense and leafy.

1. *B. capitatum*.

Leaves entire, except the hastate teeth at the cuneate base; inflorescence slender and naked above.

2. *B. hastatum*.

1. *Blitum capitatum* L. In rocky soil from N. S. to Alaska, N. J. and Calif.—Alt. 6000–10,000 ft.—Mountains between Sunshine and Ward, Boulder Co.; Hamor's Lake, above Durango; Georgetown; Sangre de Cristo Creek; North Park; Gunnison; Veta Pass; La Veta; Minnehaha; Ouray; Breckenridge; Anchor; Poudre Cañon; Elizabethtown; Chambers' Lake; Buena Vista; forks of Poudre and Big-tooth.

2. *Blitum hastatum* Rydb. In stony ground from Wyo. to Utah and Colo.—Alt. 6000–9500 ft.—Big Creek Gulch, Routt Co.; Trapper's Lake.

3. CYCLOLOMA Moq.

1. *Cycloloma atriplicifolium* (Spreng.) Coult. (*C. platyphyllum* Moq.) In sandy soils from Ont. to Mont., Ark. and Ariz.—Alt. 4000–6000 ft.—La Salle; Denver; New Windsor, Weld Co.; near Boulder; Elk Cañon.

4. MONOLEPIS Schrad.

Leaves lanceolate, hastately lobed, flower clusters several flowered; pericarp somewhat fleshy.

1. *M. Nuttalliana*.

Leaves spatulate, entire; flower-clusters 1–3-flowered; pericarp thin.

2. *M. pusilla*.

1. *Monolepis Nuttalliana* (R. & S.) Engelm. (*M. chenopodioides* Moq.) In alkaline soil from Minn. to Wash., Tex. and Calif.—Alt. 4000–9000 ft.—Near Bents' Fort; valley near Empire; Sangre de Cristo Creek; headwaters of Pass Creek; Arboles; Durango; vicinity of Fort Collins; Gunnison; New Windsor, Weld Co.; Buena Vista; Montrose; Platte River Valley; Grand Junction; Fort Collins.

2. *Monolepis pusilla* Torr. In alkaline soil from Wyo. and Colo. to Calif.—Grand Junction.

5. ATRIPLEX L. Orache.

Annuals.

Bracts united only at the base; radicle inferior.

Bracts thin, broadly ovate, mucronate.

17. *A. hortensis*.

Bracts thick, deltoid or lanceolate, acute.

Stem tall, erect; leaves broadly ovate or triangular-hastate.

1. *A. carnosa*.

Stem low, 2–4 dm. high, spreading or ascending; leaf-blades lanceolate, hastately lobed.

2. *A. subspicata*.

Bracts united to above the middle; radicle superior.

Bracts usually broadly cuneate, truncate at the apex, seldom with tubercles; leaves linear. 3. *A. Wolffii*.

Bracts rhombic-orbicular, conspicuously toothed and appendaged, or tubercled on the back; leaf-blades rhombic, cordate or ovate.

Leaf-blades large, more or less hastate, truncate or cuneate at the base.

Leaf-blades rhombic-deltoid, minutely scurfy, acute.

Leaves sessile or the lower short petioled with winged petioles, very thin; plant a tumble-weed, 1-3 m. in diameter. 4. *A. expansa*.

Leaves petioled, firmer; plant scarcely a tumble-weed.

5. *A. argentea*.

6. *A. cornuta*.

Leaf-blades small, 1 cm. or less, ovate-lanceolate, rounded at the base, sessile, firm.

7. *A. philonitira*.

Perennials.

Bracts not winged on the back.

Bracts with entire margins or merely wavy, without appendages on the back; leaf-blades entire, broadly oval. 8. *A. confertifolia*.

Bracts either with a distinctly toothed margin or appendaged on the back, or both.

Bracts broadest above the middle.

Bracts 3-toothed, only rarely tubercled on the back.

9. *A. eremicola*.

Bracts entire, strongly tubercled or appendaged on the back.

10. *A. corrugata*.

Bracts broadest below the middle, strongly tubercled or appendaged; leaf-blades oblanceolate to spatulate.

Leaf-blades oblanceolate or narrowly spatulate, sessile or short-petioled.

Low; leaves usually short-petioled; staminate flowers brown-puberulent, in panicles. 11. *A. oblanceolata*.

Usually tall; leaves sessile; staminate flower yellow in interrupted spikes. 12. *A. Nuttallii*.

Leaf-blades broadly spatulate, distinctly petioled; staminate spikes brown, interrupted. 13. *A. cuneata*.

Bracts broadly 4-winged on the back.

Wings thick, lacinate-toothed.

14. *A. odontoptera*.

Wings thin, sinuately dentate or subentire.

Wings when fully developed 4-6 mm. wide, distinctly dentate; leaves broad, linear-oblong to spatulate. 15. *A. canescens*.

Wings very broad and thin, fully 8 mm. wide, merely sinuate; leaves linear. 16. *A. occidentalis*.

1. *Atriplex carnea* A. Nels. (*A. patula hastata* of Coulter's Man.) In alkaline or saline meadows from Nebr. to Mont. and Kan.—Fort Collins.

2. *Atriplex subspicata* (S. Wats.) Rydb. (*A. patula subspicata* S. Wats.) In alkaline soil from N. D. to Mont., Colo. and Utah.—Alt. up to 9500 ft.—Pitkin; Delta.

3. *Atriplex Wolffii* S. Wats. In alkaline soil, in Wyo. and Colo.—San Luis Valley; Saguache.

4. *Atriplex expansa* S. Wats. (*A. pabularis* A. Nels.) In alkaline soil from Ind. Terr. to Mont., Tex. and Calif.—About Fort Collins; Delta.

5. *Atriplex argentea* Nutt. In alkaline flats and dry lakes from N. D. to B. C., Kans. and Colo.—Alt. 4000-5000 ft.—Grand Junction; Mancos; Pueblo; vicinity of Fort Collins.

6. *Atriplex cornuta* M. E. Jones. In alkaline soil from Colo. to Utah.—Alt. 4000-6000 ft.—Colorado Springs.

7. *Atriplex philonitra* A. Nels. In alkaline soil, in the plain regions of Wyo. and Colo.—Alt. 4000–5000 ft.—Mancos; Grand Junction; plains of the San Juan; Hotchkiss; between Hotchkiss and Smith's Fork; Delta Co.

8. *Atriplex confertifolia* S. Wats. On mesas and alkaline flats from Wyo. to Nev., Colo., Ariz. and Calif.—Alt. 4000–6000 ft.—Pueblo; Mancos; Rifle, Garfield Co.; Denver; Grand Junction; Deer Run; Delta; Hotchkiss; Pali-sades.

9. *Atriplex eremicola* Osterh. On saline bottom-lands and dry plains in southern Wyo. and northern Colo.—North Park; Grand Junction.

10. *Atriplex corrugata* Watson. On arid plains of Colo.—Hotchkiss, Delta Co.

11. *Atriplex oblanceolata* Rydb. On arid plains of Wyo. and Colo.—Delta; Hotchkiss; Grand Junction; Fort Collins.

12. *Atriplex Nuttallii* S. Wats. In bad-lands and arid valleys from Sask. to Mont., Colo. and Nev.—Alt. 4000–6000 ft.—Arboles; Cañon City; Grand Junction; about Fort Collins; Hotchkiss; Gypsum; Fossil Creek.

13. *Atriplex cuneata* A. Nelson. In arid places of Utah and Colo.—“South-western Colorado”; Grand Junction (*Nelson*). The Mancos specimens cited by Nelson belong to *A. confertifolia*.

14. *Atriplex odontoptera* Rydb. On dry plain of Wyo. and N. Colo.—Alt. about 5000 ft.—New Windsor.

15. *Atriplex canescens* James. On dry mesas and alkaline valleys from S. D. to Wyo., Kans., N. M. and Calif.—Alt. 4000–7000 ft.—Wolcott; Walsenburg; Fort Collins; Cañon City; Huerfano Valley; Grand Junction; Pueblo; between Bents' Fort and Upper Pueblo; Olathie; Gypsum; Hotchkiss, Delta Co.

16. *Atriplex occidentalis* Torr. On dry mesas from Colo. to Utah, Texas and Ariz.—Alt. 4000–7000 ft.—Boulder; Huerfano Valley; Mancos; Pueblo.

17. *Atriplex hortensis* L. Escaped from cultivation in waste places.—Alt. up to 7000 ft.—Boulder; Glenwood Springs; La Veta; vicinity of Fort Collins.

6. **SUCKLEYA** A. Gray.

1. *Suckleya Suckleyana* (Torr.) Rydb. (*S. petiolata* A. Gray.) River valleys from Mont. to Colo.—Alt. 5000–6000 ft.—Six miles southeast of Golden; Cheyenne Wells; Denver.

7. **GRAYIA** H. & A.

1. *Grayia Brandegei* A. Gray. In desert regions of Colo.—Hill's ranch, Elmo Creek.

8. **EUROTIA** Adans. WHITE SAGE, WINTER SAGE.

1. *Eurotia lanata* (Pursh) Moq. On hillsides and sage plains from S. D. to Wash., Kans. and Calif.—Alt. 4000–8000 ft.—Fort Collins; Salida; New Windsor; Gunnison; La Veta; Trail Glen; Grand River, above Kremmling; Boulder; bluffs north of La Porte; Barlow ranch, three miles from Forks' Hotel; banks of Cache la Poudre; Gypsum; Fort Collins.

9. **KOCHIA** Rath.

Perennials; leaves narrowly linear, fleshy.

Branches tomentulose, soon glabrate; leaves somewhat hairy when young; fruit nearly smooth.

Branches and leaves densely and permanently hairy; fruit very pubescent.

Annual; leaves linear-lanceolate, not fleshy.

1. *K. americana*.

2. *K. vestita*.

3. *K. scoparia*.

1. ***Kochia americana*** S. Wats. In alkaline meadows and marshes from Wyo. to Cal., Colo. and Ariz.—Alt. about 4600 ft.—Grand Junction.

2. ***Kochia vestita*** S. Wats. In alkaline meadows and marshes from Wyo. to Cal. and Colo.—Alt. 4000–6000 ft.—Grand Junction; McElmo Cañon.

3. ***Kochia scoparia*** Schrad. Introduced from Europe and sparingly growing in waste places from N. Y. and Mich. to Pa. and Colo.—Alt. about 5000 ft.—Fort Collins; New Windsor.

10. **CORIOSPERMUM** L. BUG-SEED.

Fruit with a distinct wing at least $\frac{1}{2}$ mm. wide.

Spike lax; lower bracts much narrower than the fruit.

Spike dense; lower bracts rarely narrower than the fruit.

Fruit merely acute, margined, scarcely winged.

Plant glabrous.

Plant more or less villous.

1. *C. nitidum*.

2. *C. marginale*.

3. *C. emarginatum*.

4. *C. villosum*.

1. ***Coriospermum nitidum*** Kit. (*C. hyssopifolium microcarpum* S. Wats.) On sand-hills and in cañons from Ills. to N. D., Tex. and Colo.; also in Europe and Asia.—Alt. 4000–7000 ft.—Huerfano Valley; Colorado Springs; Cañon City.

2. ***Coriospermum marginale*** Rydb. In valleys of Wyo. and Colo.—Alt. 4000–7000 ft.—Denver; Huerfano Valley; Rocky Ford; near Boulder.

3. ***Coriospermum emarginatum*** Rydb. In valleys of Wyo. and Colo.—Colorado (exact locality not given).

4. ***Coriospermum villosum*** Rydb. In sandy valleys from Alb. to Ore., Colo. and Nev.—Alt. 7000–8000 ft.—Salida; Gunnison; Buena Vista.

11. **SALICORNIA** L. GLASS-WORT.

1. ***Salicornia herbacea*** L. (*S. rubra* A. Nelson.) In salt marshes from Que. to B. C., Ga. and Calif.—North Park; Larimer Co.

12. **SARCOBATUS** Nees. GREASE-WOOD.

1. ***Sarcobatus vermiculatus*** (Hook) Torr. In dry alkaline or saline soil from Neb. to Wash., Tex. and Calif.—Alt. 4000–9000 ft.—Salida; Mancos; Grand Junction; Mancos Cañon; Lake John, North Park; near Montrose; Walsenburg; Olathe; Black Cañon of the Gunnison; Gypsum; Middle Park.

13. **DONDIA** Adans. SEA BLITE.

Sepals more or less fleshy, but none of them carinate; leaves narrowed at the base.

Plant perennial, stout.

Plant annual, slender.

1. *D. Moquini*.

2. *D. diffusa*.

Sepals very fleshy, one or two decidedly carinate; leaves broadest near the base.

Plant depressed, spreading.

3. *D. depressa*.

Plant erect.

4. *D. erecta*.

1. *Dondia Moquini* (Torr.) A. Nels. (*Chenopodium Moquini* Torr.; *Suaeda Torreyana* S. Wats.) In salt marshes from Wyo. to Nev., Colo. and Lower Calif.—Cañon City; Hotchkiss.

2. *Dondia diffusa* (S. Wats.) Heller. (*Suaeda diffusa* S. Wats.) In salt marshes from Nebr. to Nev. and Colo.—Alt. 4000-6000 ft.—Salida; Grand Junction; Mancos; Cañon City; Delta; Pueblo.

3. *Dondia depressa* (Pursh) Britton. (*Salsola depressa* Pursh; *Suaeda depressa* S. Wats.) In salt marshes from Sask. to Mont., Colo. and Nev.—Alt. up to 8000 ft.—Buena Vista; river bottom land, Fort Collins; Delta.

4. *Dondia erecta* (S. Wats.) A. Nels. (*Suaeda depressa erecta* S. Wats.) In salt marshes from N. D. to Mont., Colo. and Nev.—Alt. 4000-9000 ft.—Grand Junction; Lake John, North Park; Fort Collins; Pueblo; along Poudre River.

14. *SALSOLA* L. RUSSIAN THISTLE, SALT-WORT.

1. *Salsola Tragus* L. In waste places and old fields; introduced from Europe and naturalized from Ont. to Wash., Mo. and Colo.—Alt. 4000-7000 ft.—Near Boulder; Pueblo; Denver; Huerfano Valley; Cañon City; Walsenburg; La Salle.

Family 46. *AMARANTHACEAE* J. St. Hil. *AMARANTH* FAMILY.

Antthers 2-celled; green plants with alternate leaves.

Perianth present in all flowers.

1. *AMARANTHUS*.

Perianth wanting in the pistillate flowers.

2. *ACNIDA*.

Antthers 1-celled; stellate or woolly plants with mainly opposite leaves.

Filaments united into a short cup at the base; calyx neither crested nor spiny; plants stellate, diffuse.

3. *CLADOTRIX*.

Filaments united into a long tube; calyx crested and tubercled or spiny at maturity; plants woolly, erect.

4. *FROELICHIA*.

1. *AMARANTHUS* L. *AMARANTH*, *PIGWEED*.

Sepals clawed; flowers in terminal and axillary spikes.

Bracts lanceolate, shorter than the flowers.

1. *A. Torreyi*.

Bracts subulate, longer than the flowers.

2. *A. Palmeri*.

Sepals not clawed.

Plants tall, simple; flowers in terminal and axillary spikes.

Stamens 3; sepals 1-2 mm. long.

3. *A. Powellii*.

Stamens 5; sepals 2-3 mm. long.

Spikes stout, 8-14 mm. thick, strict; stem usually more or less pubescent.

4. *A. retroflexus*.

Spikes slender, 4-6 mm. thick, usually drooping; stem glabrous.

5. *A. hybridus*.

Plant low, much branched; flowers in small axillary spikes, shorter than the leaves.

Sepals 4-5; bracts lanceolate-subulate, a little longer than the sepals; plant prostrate.

6. *A. blitoides*.

Sepals 3; bracts much longer than the sepals, pungent; plant erect, glabrous.

7. *A. graecisens*.

1. *Amaranthus Torreyi* (A. Gray) Benth. (*Amblogyne Torreyi* A. Gray.) In sandy soil from Iowa and Wyo. to Mex. and L. Cal.—Alt. 4000–5000 ft.—Fort Collins; north fork of Gunnison, Delta Co.
2. *Amaranthus Palmeri* S. Wats. In sandy soil from Kans. and Colo. to Tex. and Ariz.; also in Mex.—Alt. about 6000 ft.—Clear Creek Cañon, above Golden.
3. *Amaranthus Powellii* S. Wats. In sandy valleys from Colo. to Texas and Calif.—Alt. up to 9000 ft.—Southeast of Ouray; Boulder; Alamosa.
4. *Amaranthus retroflexus* L. In waste places from Vt. to Ida., Fla. and Mex.; naturalized from Europe.—Alt. up to 6000 ft.—Denver; Cheyenne Mountain; Fort Collins; Durango.
5. *Amaranthus hybridus* L. In waste places from R. I. to Colo., Fla. and Calif.; also in Mex.; naturalized from Europe.—Upper Rio Grande; exact locality not given.
6. *Amaranthus blitoides* S. Wats. In dry grounds, roadsides and waste places from N. Y. to Mont., La. and Calif.—Alt. 4000–10,000 ft.—Pike's Peak trail; Manitou; Colorado Springs; Ouray; Buena Vista; Durango; vicinity of Fort Collins.
7. *Amaranthus graecizans* L. (*A. albus* L.) In cultivated grounds and waste places from R. I. to Wash., Fla. and Ariz.; introduced from tropical America.—Alt. 4000–6000 ft.—Colorado Springs; Fort Collins.

2. ACNIDA L. WATER HEMP.

1. *Acnida tamariscina* (Nutt.) Wood. In alluvial soil from Ill. to S. D., La. and N. M.—Alt. up to 5000 ft.—Fort Collins.

3. CLADOTRIX Nutt.

1. *Cladotrix lanuginosa* Nutt. In dry soil from Kans. to Colo., Tex., Ariz. and Mex.—Rocky Ford.

1. FROELICHIA Moench.

Stout, 6–12 dm. tall; crest of fruiting calyx continuous, dentate. 1. *F. campestris*.
Slender, 2–5 dm. high; crest of fruiting calyx interrupted. 2. *F. gracilis*.

1. *Froelichia campestris* Small. (*F. Floridana* Coult.; in part.) In sandy soil from Mo. to Colo. and Tex.—Alt. about 5000 ft.—New Windsor, Weld Co.

2. *Froelichia gracilis* Moq. In sandy valleys from Neb. to Colo., Ark. and Texas.—Alt. 4000–6000 ft.—Boulder; Colorado Springs; Denver; along Poudre; Fort Collins; Manitou; Ute Pass.

Family 47. CORRIGIOLACEAE Reichenb. WHITLOW-WORT FAMILY.

1. PARONYCHIA Adans. WHITLOW-WORTH.

Flowers solitary; leaves scarcely exceeding the bracts; plants densely pulvinate.

Leaves elliptic, thick, not spinulose-tipped.

1. *P. pulvinata*.

Leaves linear, chartaceous, spinulose-tipped.

Leaves arcuate, spreading; spinules of sepals over 1 mm. long.

2. *P. sessiliflora*.

Leaves straight, ascending; spinules of sepals less than 1 mm.

3. *P. brevispina*.

Flowers more or less clustered; leaves much longer than the bracts.

Plant low and diffuse, less than 1 dm. high; calyx fully 3 mm. long.

4. *P. diffusa*.

Plant taller, 1 dm. or more high; stem erect or ascending; calyx 2-2.5 mm. long.

Branches of the cymes ascending; calyx about 2.5 mm. long; sepals lanceolate, gradually acuminate.

5. *P. Jamesii*.

Branches of the cymes divaricate; calyx about 2 mm. long; sepals oblong, abruptly acuminate.

6. *P. Wardii*.

1. *Paronychia pulvinata* A. Gray. On exposed mountain tops from Wyo. to Colo. and Utah.—Alt. 11,000-14,000 ft.—Cameron Pass; Mt. Garfield; Gray's Peak; Pike's Peak trail; Massif de l'Arapahoe; Berthoud Pass.

2. *Paronychia sessiliflora* Nutt. On dry ridges from Sask. to Alb., Tex. and Utah.—Alt. 5000-8000 ft.—Upper Larimer River.

3. *Paronychia brevispina* (A. Nels.) Rydb. (*P. sessiliflora brevispina* A. Nels.) On dry hills in Wyo. and Colo.—Waldon, North Park.

4. *Paronychia diffusa* A. Nels. On dry plains and mountains from S. D. to Wyo., Kans. and Colo.—Alt. 5000-13,000 ft.—Castle Rock, near Golden; Gray's Peak; Pike's Peak trail; Table Rock.

5. *Paronychia Jamesii* T. & G. On dry plains and mountains from Neb. to Wyo., Tex. and N. M.; also in Mex.—Alt. 4000-10,000 ft.—Ruxton Ridge; Pike's Peak; river flats east of Ft. Collins; Horsetooth Mountain; mountains between Sunshine and Ward; Boulder; Larimer Co.; Morrison; Meadow Park, Lyons; Colorado City; Spring Cañon; Ft. Collins; Horsetooth Mountain.

6. *Paronychia Wardii* Rydb. On dry plains from Neb. to Colo., Kans. and Tex.—Alt. up to 7000 ft.—Colorado City; Cheyenne Mountain.

Family 48. **ALLIONIACEAE** Reichenb. FOUR-O'CLOCK FAMILY.

Bracts distinct.

1. **ABRONIA**.

Bracts united.

Fruit neither strongly tubercled nor winged.

Fruit not ribbed; involucre herbaceous, little if at all enlarging in fruit, not becoming membranous.

Stamens usually 5; involucres campanulate, not enlarged in fruit.

2. **QUAMOCLIDION**.

Stamens 3; involucre rotate, somewhat enlarged in fruit in the manner of the next genus, but not membranous.

3. **ALLIONIELLA**.

Fruit ribbed; involucre rotate, in fruit becoming much enlarged and membranous.

4. **ALLIONIA**.

Fruit with two rows of strong tubercles on the back and surrounded by two toothed inflexed wings.

5. **WEDELIA**.

1. **ABRONIA** Juss.

Fruit narrowly winged or crested; wings or crests not completely encircling the fruit.

Fruit biturbinate, *i. e.*, tapering at both ends, irregularly ridged or crested.

1. *A. fragrans*.

Fruit turbinate or obpyramidal, *i. e.*, almost truncate above, distinctly winged; the wings very broad above.

Bracts broadly ovate or obovate, acute or obtusish.

- Stem puberulent. 2. *A. elliptica*.
 Stem glabrous. 3. *A. glabra*.
 Bracts oblong-lanceolate or lanceolate, attenuate or cuspidate. 4. *A. Carletoni*.
 Fruit completely surrounded by the broad netted-veined membranous wings.
 Flowers 3 cm. or more long; limb about 1 cm. wide; peduncles longer than the leaves. 5. *A. cycloptera*.
 Flowers 1.5-2 cm. long; limb about 5 mm. wide. 6. *A. micrantha*.
1. *Abronia fragrans* Nutt. In dry sandy soil from S. D. to Ida., Kans. and N. M.—Alt. 4000-7000 ft.—New Windsor, Weld Co.; Crow Creek; Ft. Collins; Salida; Cucharas River, below La Veta; Walsenburg; near Pueblo; Table Rock; Fossil Creek; Colorado Springs.
2. *Abronia elliptica* A. Nels. (*A. Bakeri* Greene.) In sandy soil in Wyo. and Colo.—Alt. 4000-5000 ft.—Deer Run; Grand Junction; Rifle, Garfield Co.
3. *Abronia glabra* Rydb. In dry arid soil in Colo. and Utah.—Grand Junction; near Ft. Collins; Hotchkiss.
4. *Abronia Carletoni* Coult. & Fisch. Dry plains of Colo.—Alt. about 5000 ft.—Ft. Collins.
5. *Abronia cycloptera* A. Gray. Plains from Wyo. to Tex. and Calif.—Exact locality not given.
6. *Abronia micrantha* A. Gray. On dry mesas and in sandy soil from S. D. to Mont. and N. M.—Alt. 4000-9000 ft.—Near Pike's Peak; Crow Creek; Cañon City; Grand Junction; Trinidad; valley of upper Arkansas River; Swallows, between Cañon City and Pueblo; near Badito; near Pueblo; headwaters of Sangre de Cristo Creek; Walsenburg; Salida; New Windsor; Conejos River, north of Antonito.

2. **QUAMOCLIDION** DC. FOUR-O'CLOCK.

1. *Quamoclidion multiflorum* Torr. (*Mirabilis multiflora* A. Gray.) In valleys from Colo. to Utah, Texas and Ariz.—Alt. 4000-7000 ft.—Florence; Pueblo; Deer Run; Cucharas Junction; Cañon City; Cucharas Valley, near La Veta; Grand Junction; Cimarron; Pueblo; Florence.

3. **ALLIONIELLA** Rydb.

1. *Allioniella oxybaphoides* (A. Gray) Rydb. (*Mirabilis oxybaphoides* A. Gray) In valleys from Colo. to Utah and Tex.—Alt. 7000-8000 ft.—Salida; Buena Vista; Trail Glen.

4. **ALLIONIA** Loeffl. UMBRELLA-WORT.

- Leaves from cordate to broadly ovate-lanceolate; all distinctly petioled.
 1. *A. nyctaginea*.
 Leaves ovate-lanceolate, oblong or linear, sessile or only the lower short-petioled.
 Involucres in open terminal cymes.
 Stem more or less hirsute as well as viscid.
 Leaves ovate or broadly oblong, as well as the stem conspicuously hirsute.
 2. *A. hirsuta*.
 Leaves linear-lanceolate, almost glabrous; stem sparingly hirsute or glabrous except under the nodes.
 3. *A. pilosa*.
 Stem glabrous below, not hirsute, viscid-puberulent above.
 4. *A. sessilifolia*.
 Lower leaves ovate, rounded at the base.
 Lower leaves lanceolate to linear, tapering at the base.

Leaves erect or ascending; lobes of the involucre rounded or broadly triangular-ovate.

Plant prostrate or diffuse; involucre and branches of the inflorescence densely viscid hairy. 5. *A. diffusa*.

Plants more simple, erect or ascending; branches of the inflorescence usually merely viscid-puberulent.

Leaves from ovate or obovate to linear-lanceolate, usually over 5 mm. wide. 6. *A. lanceolata*.

Leaves narrowly linear, less than 5 mm. wide. 7. *A. linearis*.

Leaves divergent; lobes of the involucre elliptic or oval.

8. *A. divaricata*.

Involucre on solitary axillary peduncles, rarely also in small dense terminal clusters. 9. *A. Bodinii*.

1. *Allionia myctaginia* Michx. (*Oxybaphus myctaginius* Sweet) In alluvial soil from Ill. to Sask., Mo. and Colo.—Alt. 4000-5000 ft.—Denver; Ft. Collins; buttes along Poudre River, near Ft. Collins.

2. *Allionia hirsuta* Pursh. On plains and sandy valleys from Minn. to S. D., Nebr. and Colo.—Alt. 4000-7000 ft.—Cheyenne Mountain; Manitou; Colorado Springs; Cucharas Valley, near La Veta; North Cheyenne Cañon; Colorado Springs; Englemann Cañon; vicinity of Ft. Collins.

3. *Allionia pilosa* (Nutt.) Rydb. In dry and sandy soil from Wis. to Sask., La. and Tex.—Alt. 4000-7000 ft.—New Windsor, Weld Co.; La Veta.

4. *Allionia sessilifolia* Osterhout. Plains of Colo.—Livermore.

5. *Allionia diffusa* Heller. In sandy soil and on plains from N. D. to Wyo., Kans. and Ariz.—Alt. 4000-9000 ft.—Minnehaha; Piedra; Ft. Collins; Pueblo; Horsetooth Gulch; Table Rock; Hotchkiss; above Rustic; Grand Junction.

6. *Allionia lanceolata* Rydb. On plains and prairies and in dry sandy soil from Minn. to Wyo., Tenn., Tex. and Colo.—Alt. 5000-7000 ft.—Estes Park, Larimer Co.; Cañon City; New Windsor, Weld Co.; vicinity of Ft. Collins.

7. *Allionia linearis* Pursh. (*Oxybaphus angustifolius* Sweet.) On dry plains from Minn. to Mont., La. and Ariz.; also in Mex.—Alt. 4000-9000 ft.—Grand Cañon of Arkansas; Platte River, Denver; Grand Junction; southeast of Ouray; Parlin, Gunnison, Co.

8. *Allionia divaricata* Rydb. In sandy valleys from Colo. to N. M. and Ariz.—Durango.

9. *Allionia Bodinii* (Holz.) Morong. (*Oxybaphus Bodinii* Holz.) On dry mesas from Colo. to Utah and Tex.—Alt. 4000-6000 ft.—Pueblo; Ft. Collins.

5. WEDELIA Loeffl.

1. *Wedelia incarnata* L. In valleys from Colo. to Tex. and Ariz.; also Mexico and Tropical America.—Cañon City (*Greene*).

Family 49. TETRAGONIACEAE Reichenb. CARPET-WEED FAMILY.

1. SESSUVIUM L. SEA-PURSLANE.

1. *Sessuvium sessile* Pers. On saline plains from Kans. to Nev., Tex. and Calif.; also Mex.—Alt. about 8000 ft.—Alamosa.

Family 50. **PORTULACACEAE** Reichenb. PURSLANE FAMILY.

Ovary superior.

Sepals 2.

Sepals deciduous; capsule 3-valved.

1. **TALINUM**.

Sepals persistent.

Capsule 3-valved from the apex.

Plants with corms or fleshy roots; stem-leaves opposite. 2. **CLAYTONIA**.

Plants with slender rootstocks or annual roots.

Stem with a single sessile pair of leaves, with an erect or ascending rootstock or in ours annual roots. 3. **LIMIA**.Stem decumbent or floating, with several pairs of stem-leaves, rooting at the nodes and producing filiform runners, forming bulblets at the apex. 4. **CRUNOCALLIS**.

Capsule circumscissile near the base.

Plants with fleshy roots and short caudices and numerous basal leaves. 5. **OREOBROMA**.6. **EROCALLIS**.Plants with globose corms and 2-3 cauline leaves. 7. **LEWISIA**.

Sepals 4-8.

Ovary partly inferior; upper portion circumscissile, falling off with the sepals. 8. **PORTULACA**.1. **TALINUM** Adans. FAME-FLOWER.

Flowers about 1 cm. wide; stamens 5.

1. *T. parviflorum*.

Flowers 2-3 cm; stamens many.

2. *T. calycinum*.

1. *Talinum parviflorum* Nutt. (*T. teretifolium* Porter & Coult.; not L.) In rocky soil from Minn. to S. D., Tex. and Ariz.; also in Mex.—Alt. 4000-7000 ft.—Garden of the Gods; Denver, along the Platte River; Ft. Collins; Mason's river-front farm; Spring Cañon.

2. *Talinum calycinum* Engelm. In sandy soil from Ark. to Colo., Tex. to N. M.—Exact locality not given.

2. **CLAYTONIA** L. SPRING BEAUTY.

Plant with rounded corms; basal leaves few.

Stem leaves linear or narrowly lanceolate, 1-ribbed or indistinctly 3-ribbed.

Leaves petioled; corolla white.

1. *C. virginiana*.

Leaves sessile; corolla pink.

2. *C. rosea*.

Stem leaves broadly lanceolate, distinctly 3-ribbed.

3. *C. lanceolata*.

Plants with a short caudex and a fleshy tap root; basal leaves numerous.

4. *C. megarrhiza*.

1. *Claytonia virginiana* L. Around springs from N. S. and Mont. to Va., Tex. and Colo.—Alt. 5000-7000 ft.—Foot-hills, Ft. Collins; Soldier Cañon; Larimer Co.

2. *Claytonia rosea* Rydb. In rich damp soil in Wyo. and Colo.—Alt. 7000-8000 ft.—Graham's Peak; hills southeast of La Veta.

3. *Claytonia lanceolata* Pursh. (*C. Caroliniana sessilifolia* Torr.) In wet rich soil from Sask. and B. C. to Colo. and Calif.—Alt. up to 9000 ft.—Howe's Gulch; gulch west of Dixon Cañon; Horsetooth Gulch; Grand Mesa.

4. *Claytonia megarrhiza* Parry. Among rock-slides, on the higher mountains, from Mont. to Colo. and Utah.—Alt. 8000-14,000 ft.—West Spanish Peak; Cameron Pass; Gray's Peak; Central City; James' Peak; Pike's Peak; near Pagosa Peak; Little Kate Basin, La Plata Mountains; Como; Boreas;

Carson; Mt. Bartlett; Robinson; mountains near Empire; Massif de l'Arapahoe; Lake City; headwaters of Clear Creek; mountains northwest of Como; Boreas; Devil's Causeway; Berthoud Pass; Ethel Peak.

3. LIMNIA L. SPANISH LETTUCE

1. *Limnia depressa* (A. Gray) Rydb. (*Claytonia parviflora depressa* A. Gray) On river banks and near springs from S. D. to Wash., Colo., Ariz. and Calif.—Reported from Colorado, but doubtful.

4. CRUNOCALLIS Rydb. WATER SPRING BEAUTY.

1. *Crunocallis Chamissonis* (Esch.) Rydb. (*Claytonia Chamissonis* Esch.) In streams from Minn. to B. C., N. M. and Calif.—Alt. 5000–10,000 ft.—Rabbit-Ear Pass; Beaver Creek; Long Gulch; Ward, Boulder Co.; Middle Park; Green Mountain Falls; North Park; Empire; Moon's ranch, Larimer Co.; Empire; Walton Creek, North Park; Baxter's ranch; Table Rock; Middle Park; Arapahoe Pass; Beaver Creek; Long Gulch.

5. OREOBROMA Howell.

Sepals not erose-denticulate.
Sepals erose-denticulate.

1. *O. nevadensis*.
2. *O. Grayi*.

1. *Oreobroma nevadensis* (S. Wats.) Howell. (*Calandrinia Nevadensis* S. Wats.) On dry mountains from Wash. to Colo. and Calif.—Steamboat Springs.

2. *Oreobroma pygmaea* (A. Gray) Howell. (*Calandrinia pygmaea* A. Gray) Dry mountain sides from Mont. to Colo. and Calif.—Alt. up to 12,000 ft.—Mountain northeast of Boreas; Ragged Mountain, Gunnison Co.; Leroux Parks; Cameron Pass; Bob Creek; Boreas; Leadville; Grayback mining camp; Arapahoe Peak.

6. EROCALLIS Rydb.

1. *Erocallis triphylla* (S. Wats.) Rydb. (*Claytonia triphylla* S. Wats.; *Oreobroma triphylla* Howell) In the mountains from Wyo. and Wash. to Colo. and Calif.—Cameron Pass.

7. LEWISIA Pursh. BITTER ROOT.

1. *Lewisia rediviva* Pursh. On stony ridges from Mont. to Colo., Ariz. and Calif.—Pinkham Creek, Larimer Co.

8. PORTULACA L. PURSLANE, PUSSLEY.

Stem prostrate; sepals pointed in the bud; seeds obscurely granulate.

1. *P. oleracea*.

Stem ascending; sepals obtuse in the bud; seeds echinate-tuberculate.

2. *P. retusa*.

1. *Portulaca oleracea* L. In waste places and cultivated soil from Maine to Mont., Fla. and Mex.—Alt. 4000–5000 ft.—Ft. Collins.

2. *Portulaca retusa* Engelm. In sandy soil from Ark. to Nev., Tex. and N. M.—Alt. up to 6000 ft.—Colorado Springs.

Family 51. **ALSINACEAE** Wahl. CHICKWEED FAMILY.

Stipules wanting.

Petals 2-cleft or 2-parted.

Capsule short ovate or oblong; styles usually 3.

1. *ALSINE*.

Capsule long, cylindric and often curved; styles usually 5.

2. *CERASTIUM*.

Petals entire or merely notched.

Styles as many as the sepals and alternate with them.

3. *SAGINA*.

Styles fewer than the sepals or if occasionally of the same number opposite them.

Seeds with a basal membranous appendage (strophiole) at the hylum.

4. *MOEHRINGIA*.

Seeds not strophiolate.

Capsules opening by twice as many valves as the styles.

5. *ARENARIA*.

Capsules opening by as many valves as the styles.

6. *ALSINOPSIS*.

Stipules present.

7. *TISSA*.1. **ALSINE** L. STARWORT. CHICK-WEED, STITCHWORT.

Lower leaves ovate, abruptly contracted into a distinct petiole.

1. *A. media*.

Leaves all sessile or subsessile.

Plant not at all viscid.

Upper bracts at least scarious.

Petals minute or none; branches of the inflorescence at last reflexed.

2. *A. baicalensis*.

Petals equalling or exceeding the sepals; branches of the inflorescence ascending.

Leaves broadest about the middle, narrowed at the base.

3. *A. longifolia*.

Leaves broadest near the base.

Leaves narrowly linear-lanceolate, light green; flowers usually many.

4. *A. longipes*.

Leaves lanceolate, bluish green; flowers few, often solitary.

5. *A. laeta*.

None of the bracts scarious.

Leaves linear to lanceolate, more than four times as long as broad.

Petals equalling or exceeding the sepals.

Plant low, less than 1 dm. high, bluish green.

5. *A. laeta*.

Plant tall, light green; stem over 1 dm. long.

6. *A. borealis*.

Petals much shorter than the sepals or none.

7. *A. crassifolia*.

Leaves ovate-lanceolate, ovate or oval, less than four times as long as broad.

Leaves thin.

Stem glabrous or nearly so; sepals obtuse.

8. *A. obtusa*.

Stem distinctly pubescent; sepals acutish.

9. *A. calycantha*.

Leaves very thick and fleshy.

10. *A. polygonoides*.

Plant more or less viscid, especially the upper portion.

11. *A. Jamesiana*.1. *Alsine media* L. (*Stellaria media* Cyr.) Introduced around dwellings. Native of Europe and Asia.—Ft. Collins.2. *Alsine baicalensis* Coville. (*Stellaria umbellata* Turcz.) Along mountain streams from Mont. to Ore., Colo. and Calif.—Alt. 8000–14,000 ft.—Cameron Pass; Red Mountain; Seven Lakes; Buffalo Pass; Beaver Creek; Ouray; Ruby; West Spanish Peak; Grayback mining camps; Silver Plume; near Pagosa Peak; Middle Park; Mt. Hesperus; Trapper's Lake; Pike's Peak; Gray's Peak; Ironton; Argentine Pass; northeast of Boreas; Eldora to Baltimore; summit of North Park Range, Larimer Co.

3. *Alsine longifolia* (Muhl.) Britt. (*Stellaria longifolia* Muhl.) In wet meadows from Newf. to Alaska, Md. and Colo.—Alt. 4000–11,000 ft.—Pike's Peak; Sangre de Cristo Creek; Tennessee Pass; Mancos; Larimer Co.; Andrew's Shetland ranch; Idaho Springs; Higho; Parlin; Sheephorn Divide; Gunnison; Iola; headwaters of Clear Creek; Graymont; Conejos River, north of Antonito; Baxter's ranch; Table Rock; Steamboat Springs.

4. *Alsine longipes* (Goldie) Coville. (*Stellaria longipes* Goldie) In wet meadows from Lab. to B. C. and Colo.—Alt. 8000–10,000 ft.—Leroux Parks; Caribou.

In the Rocky Mountain region it is mostly represented by var. *stricta* (Richardson) Rydb. (*Stellaria stricta* Richardson.) It differs from the type in having acute sepals. Its range extends farther southwest to Calif.—Alt. 8000–11,000 ft.—West Indian Creek; Moon's ranch, Larimer Co.; Marshall Pass; Dark Cañon; Tennessee Pass; Eldora to Baltimore.

5. *Alsine laeta* (Richards.) Rydb. In wet places in the mountain sides from Lab. to B. C., Que. and Nev.—Alt. 9000–12,000 ft.—Little Veta Mountain; West Spanish Peak; Bob and Chicken Creeks; Beaver Creek; Devil's Causeway.

6. *Alsine borealis* (Bigel.) Britt. In wet meadows from Lab. to Alaska, N. J. and Calif.—Idaho Springs; Trapper's Lake.

7. *Alsine crassifolia* (Ehrh.) Britton. (*Stellaria crassifolia* Ehrh.) Marshes and wet places from Lab. to Alaska, Que. and Colo.—Alt. about 10,000 ft.—Como.

8. *Alsine obtusa* (Engelm.) Rose. (*Stellaria obtusa* Engelm.) In wet places from Mont. to B. C., Colo., Utah and Wash.—Alt. up to 10,000 ft.—Ruby; Anthracite Creek.

9. *Alsine calycantha* (Bong.) Rydb. (*Stellaria calycantha* Bong.) In bogs and wet meadows from Mont. to Alaska, Colo. and Calif.—Alt. 9000–10,500 ft.—Bogs, Columbine; Bob Creek.

10. *Alsine polygonoides* Greene. In wet places in Colo.—Alt. about 11,500 ft.—Little Kate Basin, La Plata Mountains.

11. *Alsine Jamesiana* (Torr.) Heller. (*Stellaria Jamesiana* Torr.) In wet woodlands from Wyo. to N. M. and Calif.—Alt. 5000–9000 ft.—Howe's Gulch; Rist Cañon; Poverty Ridge; near Cimarron; mountains west of Steamboat Springs; Four-Mile Hill, Routt Co.; Mesa Verde; Cucharas River, below La Veta; Apex; hills south of Rifle, Garfield Co.; Mancos; Platte Cañon; Rabbit-Ears, Larimer Co.

2. CERASTIUM L. MOUSE-EAR CHICKWEED, POWDER-HORN.

Annual; pods 2–3 times as long as the calyx.

Pedicels in fruit 1–3 times as long as the calyx, straight or nearly so.

1. *C. brachypodum*.

Pedicels in fruit 5 times as long as the calyx or longer, strongly curved above.

2. *C. longipedunculatum*.

Perennials; pods 1–2 times as long as the calyx.

Leaves oblong, ovate or oval, mostly obtuse or acutish.

Petals 1 cm. long or more, fully twice as long as the calyx.

Sepals, at least the outer, oval, obtuse, scarious-margined at the tip as well as on the sides.

3. *C. pulchellum*.

Sepals lanceolate, acute, scarious-margined mostly only on the sides.

4. *C. Earlei*.

- Petals less than 1 cm. long.
 Sepals tinged with purple; stem depressed. 5. *C. beeringianum*.
 Sepals light green; plant not depressed. 6. *C. pilosum*.
 Leaves, except the uppermost, linear or linear-lanceolate, acute.
 Leaves of the inflorescence short, broadly ovate. 7. *C. oreophilum*.
 Leaves all linear or linear-lanceolate or linear-oblong.
 Stem villous with reflexed hairs. 8. *C. campestre*.
 Stem finely glandular puberulent.
 Leaves thin and soft, all linear or narrowly linear-lanceolate; midrib not prominent. 9. *C. scopulorum*.
 Leaves thick and firm; midrib prominent. 10. *C. occidentale*.

1. *Cerastium brachypodium* (Engelm.) Robinson. In dry sandy soil from S. D. to Mont., Mo., Tex. and Ariz.; also Mex.—Alt. 4000-7500 ft.—Mountains, Larimer Co.; Pennock's mountain ranch; gulch west of Pennock's; Ft. Collins; gulch west of Soldier Cañon; Horsetooth Gulch; Howe's Gulch; Bijou Basin.

2. *Cerastium longipedunculatum* Muhl. (*C. nutans* Ra.) In wet places from N. S. to B. C., N. C., Ariz. and Ore.—Alt. 4000-9000 ft.—Veta Pass; Iola; Veta Mountain.

3. *Cerastium pulchellum* Rydb. On alpine peaks of Colo.—Alt. 13,000 ft.—Hayden Peak.

4. *Cerastium Earlei* Rydb. In wet places among rocks in the mountains of Colorado.—Alt. 9000-12,000 ft.—Near La Plata Post Office; Little Kate Basin; Mt. Robinson; Cumberland Basin; Horsetooth Gulch.

5. *Cerastium beeringianum* C. & S. In alpine-arctic regions among rocks from Alb. to Alaska, Colo. and Ariz.—Alt. 9000-12,000 ft.—Gray's Peak; Seven Lakes; Upper West Mancos Cañon; Mt. Hesperus, at timber line; mountains of Estes Park; Bottomless Pit, near Pike's Peak; West Spanish Peak; headwaters of Clear Creek; southeast of Cameron Pass.

6. *Cerastium pilosum* Greene. In alpine places among rocks in Colo.—Alt. 5000-12,000 ft.—Mountains above Ouray; Horsetooth Gulch.

7. *Cerastium oreophilum* Greene. In wet places among the mountains from Colo. to Calif.—Alt. 5000-12,000 ft.—Seven Lakes; foot-hills, Larimer Co.; foot-hills west of Ft. Collins; Pass Creek; mountain near Veta Pass.

8. *Cerastium campestre* Greene. On hills and mountain-sides from Alb. to Yukon, Wash. and Colo.—Alt. 5000-7000 ft.—Mt. Abram, Ouray; Pike's Peak; foot-hills north of Ft. Collins; Berthoud Pass; Continental Divide; Muddy Pass; North Park; Soldier Cañon; Horsetooth Gulch; Trapper's Lake; Pennock's; Como; Dixon Cañon; Spring Cañon, Howe's Gulch; Coup Divide.

9. *Cerastium scopulorum* Greene. In mountains from Colo. to Wyo. and N. M.—Alt. 9000-11,000 ft.—Near La Plata Post Office; Little Kate Basin, La Plata Mountains; vicinity of Como; Robinson; Veta Pass; Cameron Pass; Dixon Cañon.

10. *Cerastium occidentale* Greene. On dry hills from Mont. to Colo. and Utah.—Alt. 8000-12,000 ft.—Cripple Creek road; Seven Lakes; Cameron Pass; Veta Mountain; Clear Creek Station; Empire; Horsetooth Mountain; Horsetooth Gulch; Bear Creek Cañon; Spicer, Larimer Co.; Rabbit-Ear Range, Routt Co.

3. *SAGINA* L. PEAL-WORT.

Basal leaves linear-filiform; petals shorter than the green sepals. 1. *S. saginoides*.
Basal leaves subulate; petals longer than the purple-tinged sepals.

2. *S. nivalis*.

1. *Sagina saginoides* (L.) Britton. (*S. Linnaei* Presl) In wet places, among rocks and on brook-banks from Greenl. to Alaska, Que., Colo. and Utah.—Alt. 8000–10,000 ft.—Twin Lakes; Grayback mining camps; La Plata Post Office; headwaters of Clear Creek; Cameron Pass; Buffalo Pass; Empire; Chambers' Lake.

2. *Sagina nivalis* Fries. In arctic-alpine localities from Lab. to Alaska and Colo.—Alt. about 14,000 ft.—Gray's Peak.

4. *MOEHRINGIA* L.

Leaves elliptic-oblong or oval, usually obtuse; sepals obtuse or acutish; stem terete.

1. *M. lateriflora*.

Leaves lanceolate, acute; sepals very acute or acuminate; stem angled.

2. *M. macrophylla*.

1. *Moehringia lateriflora* (L.) Fenz. (*Arenaria lateriflora* L.) In wet places, especially among bushes, from Lab. to Alaska, N. J. and Utah.—Alt. 5000–10,000 ft.—Happy Hollow, Larimer Co.; headwaters of Pass Creek; Leroux Creek, Delta Co.; Rifle, Garfield Co.; Stove Prairie; Walton Creek.

2. *Moehringia macrophylla* (Hook.) Torr. (*A. macrophylla* Hook.) In wet places, among bushes, from Lab. to B. C., Vt. and Calif.—Alt. 10,000–12,000 ft.—Red Mountain; Slide Rock Cañon.

5. *ARENARIA* L. SANDWORT.

Leaves neither narrowly linear nor pungent.

Plant low and spreading; stem less than 1 dm. long; leaves ovate or ovate-lanceolate, less than 1 cm. long.

1. *A. polycaulos*.

Plant taller; stem 2–3 dm. long; leaves oblong or linear-oblong, over 1 cm. long.

2. *A. confusa*.

Leaves narrowly linear, more or less rigid and pungent.

Sepals ovate to ovate-lanceolate.

Inflorescence contracted and headlike.

3. *A. congesta*.

Inflorescence more open.

Flowers mostly subsessile in small glomerules at the ends of the branches of the very irregular cymes.

4. *A. Burkei*.

Flowers all pedicelled in open regular cymes; inflorescence more or less glandular.

Leaves distinctly pungent; plant sparingly glandular-puberulent.

5. *A. wintahensis*.

Leaves more fleshy, hardly pungent; inflorescence and calyx densely glandular-pubescent.

6. *A. Tweedyi*.

Sepals narrowly lanceolate, acuminate.

Cymes open, not densely congested.

Plant more or less glandular.

Plant perfectly glabrous.

7. *A. Fendleri*.

Cymes densely congested.

8. *A. Eastwoodiae*.

Sepals 8–10 mm. long; stem leaves 2–3 cm. long.

9. *A. pinetorum*.

Sepals 5–7 mm. long; stem-leaves 0.5–1.5 cm. long.

10. *A. Hookeri*.

1. *Arenaria polycaulos* Rydb. (*A. saxosa* Coulter; not *A. Gray*) On dry hills from Colo. to Ariz.—Alt. 9000–10,000 ft.—La Plata Post Office; Dark Cañon; Breckenridge; Grayback mining camps; Mt. Harvard; Silverton.

2. *Arenaria confusa* Rydb. (*A. saxosa* Robinson, in part) In sandy soil from Colo. to N. M. and Ariz.—Alt. 7500–12,000 ft.—Ouray; Wahatoya Creek; near Pagosa Peak; La Plata Mountains; Mancos.

3. *Arenaria congesta* Nutt. On dry plains from Mont. to Wash., Colo. and Calif.—Alt. 7000–10,000 ft.—Oak mesa, Delta Co.; Little Muddy Creek, Gunnison Co.; Twin Lakes; North Park; along the Michigan; Middle Park; Ouray; Cimarron.

4. *Arenaria Burkei* Howell. (*A. subcongesta* (Wats.) Rydb.) On plains and hills from Mont. to Colo. and Nev.—Alt. about 8000 ft.—Hills about Box Cañon, west of Ouray; Willow Creek, Routt Co.

5. *Arenaria uintahensis* A. Nels. Dry plains from Mont. and Ida. to Colo. and Calif.—Alt. about 8000 ft.—Mesa on the Gunnison River; Grand Junction.

6. *Arenaria Tweedyi* Rydb. On dry mountains of Colo.—Alt. about 12,000 ft.—La Plata Mountains.

7. *Arenaria Fendleri* A. Gray. On dry hills and mountains from Wyo. to N. M. and Ariz.—Alt. 7000–13,500 ft.—Mountains between Sunshine and Ward; Crystal Park; Stage Coach Mountain; butte 5 miles southwest of La Veta; Callian; Cascades, near Pike's Peak; Sangre de Cristo Creek; Cameron Pass; Crystal Lake; Colorado Springs; Caribou; headwaters of Clear Creek; Gray's Peak; Dillon Cañon; vicinity of Como; Leroux Creek; Cameron Pass; Moon's ranch; Wood's ranch; mountains between Steele's and Little Beaver; Graymont; West Cameron Pass; South Park, southeast of Jefferson; Monument; Campton's Pass; Ethel Peak.

Arenaria Fendleri Porteri Rydb. On dry mountain ridges of Colo.—Alt. 7000–13,500 ft.—Mount Ouray; Pike's Peak; Alpine Tunnel; mountains west of Como; South Park, southeast of Jefferson; Silver Plume; Georgetown; Stephan's Mine; divide between Colorado Springs and Denver; Estes Park, Larimer Co.; Pike's Peak; Little Kate Basin, La Plata Mountains; West Spanish Peak; La Plata Post Office; north of Cheyenne Cañon; Empire; Berthoud Pass.

Arenaria Fendleri diffusa Porter & Coulter. On dry mountains of Colo.—Alt. 5000–10,000 ft.—Mountains between Steele's and Little Beaver; Como; Mt. Harvard; Green Mountain Falls; Georgetown; Cheyenne Mountain; Middle Park; Boulder.

8. *Arenaria Eastwoodiae* Rydb. (*A. Fendleri glabrescens* Wats.?) On dry hills in western Colo.—Grand Junction.

9. *Arenaria pinetorum* A. Nels. On dry hills from S. D. to Ida., Neb. and Colo.—Livermore, Larimer Co.; Cedar Hills; Owl Cañon.

10. *Arenaria Hookeri* Nutt. On dry hills from Mont. to Nebr. and Colo.—Alt. 4000–7000 ft.—Larimer Co.; Cedar Hills.

6. ALSINOPSIS Small. SANDWORT.

Sepals acute or acuminate.

Petals 6–7 mm. long, much exceeding the sepals.

Petals small, scarcely exceeding the sepals.

Plant densely glandular.

Plant glabrous or nearly so.

Leaves linear-subulate, usually over 1 cm. long, 1-nerved, obtuse, more or less triangular, fleshy.

1. *A. macrantha*.

2. *A. propinqua*.

3. *A. Rossii*.

Leaves linear-lanceolate, 3-nerved, acutish, flat, less than 1 cm. long.

Sepals obtuse.

4. *A. quadrivalvis*.

5. *A. obtusiloba*.

1. *Alsinopsis macrantha* Rydb. In sandy soil in the mountains of Colo.—Little Kate Basin, La Plata Mountains.

2. *Alsinopsis propinqua* (Richards.) Rydb. (*Arenaria propinqua* Richardson; *A. verna hirta* Am. auth.; *A. verna aequicaulis* A. Nels.) In sandy soil from Hudson Bay and Mackenzie River, to B. C., Colo. to Utah.—Alt. 8000–13,000 ft.—Pike's Peak; Silverton; Saddle Cliffs; Georgetown; Little Kate Basin, La Plata Mountains; near Pagosa Peak; South Park; Boreas; Beaver Creek; Chambers' Lake; Eldora to Baltimore.

3. *Alsinopsis Rossii* (Richards.) Rydb. (*Arenaria Rossii* Richards.) In arctic-alpine regions from the arctic coast to Colo. and Wash.—Alt. 11,000–13,500 ft.—Sierra Blanca; Bald Mountain.

4. *Alsinopsis quadrivalvis* (R. Br.) Rydb. (*Arenaria quadrivalvis* R. Br.) In alpine-arctic situations, along the arctic coast of North America and on alpine peaks in Colo.—"Colorado."

5. *Alsinopsis obtusiloba* Rydb. (*Arenaria obtusa* Torr.; not All.; *A. biflora* S. Wats., in part; *A. Sajanensis* Robinson; scarcely Willd.) On exposed mountain tops from Alb. to B. C., N. M. and Utah.—Alt. 10,000–13,500 ft.—Mt. Garfield; Pike's Peak; Beaver Creek; Ward, Boulder Co.; Mount Ouray; Alpine Tunnel; Mt. Harvard; Cameron Pass; Iron Mountain; West Spanish Peak; near Pagosa Peak; Gray's Peak; Mt. Princeton; Seven Lakes; Caribou; Empire; headwaters of Clear Creek; Massif de l'Arapahoe; mountains near Como; Cameron Pass; Graymont; Beaver Creek; Berthoud Pass; northwest of Como; Gray's Peak; Cameron Pass; Graymont; Ethel Peak.

7. *TISSA* Adans. SAND SPURRY.

1. *Tissa sparsiflora* Greene. Sandy and alkaline soil from Wyo. to B. C., Colo. and Ore.—New Windsor.

Family 52. *CARYOPHYLLACEAE* Reichenb. PINK FAMILY.

Calyx-ribs, usually 10, at least twice as many as the teeth, running both into the teeth and the sinuses.

Styles mostly 3; capsule usually septate at the base.

Styles 5; capsule 1-celled to the base.

Calyx strongly 5-angled and 5-ribbed.

1. *SILENE*.

2. *LYCHNIS*.

3. *VACCARIA*.

1. *SILENE* L. CATCHFLY, CAMPION.

Annuals.

Glabrous or nearly so or the upper nodes glutinous.

Stem-leaves linear or linear-lanceolate; bracts narrowly linear-lanceolate.

Petals exceeding the sepals by 2–5 mm.; blade obovate-cuneate, 2-cleft.

1. *S. antirrhina*.

Petals none or small, not exceeding the sepals; blade cuneate, truncate or emarginate at the apex.

2. *S. antirrhina depauperata*.

Stem-leaves oblanceolate or lanceolate; bracts lanceolate, more or less scarious-margined below.

3. *S. antirrhina vaccariifolia*.

Viscid-pubescent or hirsute throughout.

4. *S. noctiflora*.

Perennials.

Calyx not much inflated.

Plant caulescent, rather tall, not densely matted.

Inflorescence thyroid-paniculate, racemiform or spicate, not leafy; flowers over 1 cm. long.

Claws and auricles of the petals narrow; the latter laciniate; leaves linear or linear-lanceolate. 5. *S. Scouleri*.

Claws and auricles of the petals broad; the latter ciliate; leaves oblanceolate. 6. *S. Hallii*.

Inflorescence leafy; the flowers borne in the axils of the branches, less than 1 cm. long.

Leaves broadly oblanceolate, spreading; branches of the inflorescence divaricate. 7. *S. Menziesii*.

Leaves narrowly oblanceolate, ascending; branches of the inflorescence usually ascending or erect. 8. *S. stellarioides*.

Plant subcaulescent, densely caespitose, dwarf. 9. *S. acaulis*.

Calyx much inflated and bladderly. 10. *S. vulgaris*.

1. *Silene antirrhina* L. In waste places from Newf. to B. C., Fla. and Calif.—Alt. 5000–6500 ft.—Palmer Lake; northwest of Soldier Cañon.

2. *Silene antirrhina depauperata* Rydb. In sandy soil from Sask. to B. C., Colo. and Ariz.—Exact locality not given.

3. *Silene antirrhina vaccariifolia* Rydb. On hillsides from Mont. and Ida. to Colo.—Alt. 5000–7000 ft.—Larimer Co.; Rist Cañon; near Golden.

4. *Silene noctiflora* L. In waste places and fields from N. S. to Man., Fla. and Utah. Naturalized from Europe.—Alt. about 5000 ft.—Ft. Collins.

5. *Silene Scouleri* Hook. In the mountain valleys and hillsides from Ida. to B. C., Colo. and Ore.—Alt. up to 9000 ft.—Near Pagosa Peak.

6. *Silene Hallii* S. Wats. In the mountains of Colo. and N. M.—Alt. 6000–12,000 ft.—Jack's Cabin, Gunnison watershed; foot-hills, Larimer Co.; Ruxton Dell; Villa Grove; Cheyenne Cañon; Mancos; Upper La Plata Cañon; headwaters of Clear Creek; Gray's Peak; Bosworth's ranch; Stove Prairie; Mt. Harvard.

7. *Silene Menziesii* Hook. In wet soil, especially among bushes, from Mont. to B. C., Neb., Colo. and Calif.—Alt. 7000–10,500 ft.—Ouray; Bob Creek; headwaters of Clear Creek; Graymont; Gore Pass; North Park; Hotchkiss; Dolores.

8. *Silene stellarioides* Nutt. Among bushes from Mont. to Wash. and Colo.—Alt. 7000–9000 ft.—Gunnison; Leroux Creek, Delta Co.; Middle Park; Mancos; Los Pinos; Sangre de Cristo Creek.

9. *Silene acaulis* L. On exposed mountain tops, often near the snow, from Greenl. to Alaska, N. H. and Ariz.—Alt. 9000–13,000 ft.—Saddle, Pike's Peak; West Spanish Peak; Mt. Hesperus and Little Kate Basin; near Pagosa Peak; Mt. Harvard; Boreas; Gray's Peak; Cameron Pass; Marshall Pass; Massif de l'Arapahoe; Crystal Lake; Beaver Creek; Leroux Creek; Ethel Peak.

10. *Silene vulgaris* (Moench) Garcke. (*S. inflata* J. E. Smith.) Introduced from Europe, in meadows and waste places, from N. B. and Ills. to N. J. and Colo.—Manitou.

2. *LYCHNIS* L.

Tall, 3 dm. high or more, several to many-flowered.

Petals included.

Petals exserted.

Low, about 1 dm. high; flowers 1–3.

1. *L. Drummondii*.

2. *L. striata*.

3. *L. montana*.

1. *Lychnis Drummondii* (Hook.) S. Wats. On dry hills and plains from Man. to B. C., N. M. and Ariz.—Alt. 4000–10,000 ft.—Sangre de Cristo Creek; Middle Park; Iron-ton Park, 9 miles south of Ouray; hills about Box Cañon, west of Ouray; Marshall Pass; Georgetown; Yampa; mountains between Sunshine and Ward; Trapper's Lake; South Park; Empire; vicinity of Como; Leroux Creek, Delta Co.

2. *Lychnis striata* Rydb. On hillsides from Wyo. to Utah and Colo.—Alt. 8000–10,000 ft.—Cameron Pass; Silver Plume.

3. *Lychnis montana* S. Wats. Mountains of Colo. and Wyo.—“Colorado”; exact locality not given.

3. VACCARIA Medic. Cow-HERB.

1. *Vaccaria Vaccaria* (L.) Britton. (*Saponaria Vaccaria* L.) In waste places from Ont. to Alaska, Fla. and Calif.—Naturalized from Europe.—Alt. 5000–8000 ft.—Cucharas Valley; Wahatoya Creek; Pagosa Springs; Boulder; Ft. Collins; Pueblo.

Order 25. RANALES.

Stamens numerous; anther-sacs opening by slits.

Gynoecium of single or several free carpels.

Submerged water plants with minute axillary sessile monoecious flowers; anthers with horn-like appendages. 53. CERATOPHYLLACEAE.

Land plants or rarely water plants with perfect or rarely dioecious flowers; anthers not with horn-like appendages. 54. RANUNCULACEAE.

Gynoecium of several united carpels; water plants with floating, reniform or orbicular-cordate leaf-blades. 55. NYMPHAEACEAE.

Stamens definite (in ours 6); anther-sacs opening by hinged valves.

56. BERBERIDACEAE.

Family 53. CERATOPHYLLACEAE. A Gray.

1. CERATOPHYLLUM L.

1. *Ceratophyllum demersum* L. In water from Newf. and Ore. to Fla. and Calif.—Platte River.

Family 54. RANUNCULACEAE Juss. CROWFOOT FAMILY.

Carpels with several ovules; fruit a follicle or a berry.

Flowers regular.

Petals inconspicuous or none, not spurred.

Fruit follicles; leaves simple; flowers solitary.

Petals wanting; leaf-blades entire or toothed.

Petals present, small, linear, clawed; leaf-blades palmately parted and toothed. 1. CALTHA.

Fruit a berry; leaves twice or thrice ternately compound; flowers racemose. 2. TROLLIUS.

3. ACTAEA.

Petals conspicuous, produced into a spur or at least saccate at the base; leaves ternately compound. 4. AQUILEGIA.

Flowers irregular.

Posterior sepal spurred.

Posterior sepal hooded, helmet-shaped or boat-shaped.

5. DELPHINIUM.

6. ACONITUM.

Carpels 1-ovuled; fruit an achene.

Petals wanting; sepals often petal-like.

Sepals imbricated in the bud; leaves all alternate, or only those subtending the inflorescence opposite.

Flowers subtended by opposite or verticillate leaf-like bracts.

Styles short, not elongated in fruit.

Styles much elongated in fruit, plumose.

Flowers not subtended by opposite or verticillate bracts; leaves all alternate, ternately compound.

Sepals valvate in the bud; leaves all opposite.

Flowers cymose-paniculate, dioecious or polygamo-dioecious; stamens and sepals spreading.

Flowers solitary, perfect.

Stamens erect; sepals thickish, more or less converging; staminodia wanting.

Stamens spreading; sepals thin, spreading from the base; staminodia often present.

Petals usually present.

Sepals spurred; small annuals with basal linear leaves; receptacle in fruit elongated-cylindrical.

Sepals not spurred; plant usually bearing cauline as well as basal leaves; receptacle in fruit spherical, conical or short-cylindric.

Achenes transversely wrinkled; petals white.

Achenes not transversely wrinkled; petals yellowish at least without.

Achenes not ribbed.

Achenes longitudinally ribbed.

Achenes compressed; leaves simple, crenate or lobed.

Achenes terete; leaves compound.

7. ANEMONE.

8. PULSATILLA.

17. THALICTRUM.

9. CLEMATIS.

10. VIORNA.

11. ATRAGENE.

12. MYOSURUS.

13. BATRACHIUM.

14. RANUNCULUS.

15. HALERPESTES.

16. CYRTORHYNCHA.

1. CALTHA L. MARSH-MARIGOLD, MEADOW-GOWAN.

1. *Caltha leptosepala* Hook. (*C. rotundifolia* (Huth) Greene; *C. chiono-
phila* Greene.) Along brooks and below the snow from the Canadian Rockies to Colo.—Alt. 8000-12,000 ft.—Cameron Pass; Graymont; Beaver Creek; Alpine Tunnel; Bear Creek Divide; Marshall Pass; Pike's Peak; Red Mountain, south of Ouray; Columbine; Grand Mesa; Carson; Gore Pass; Seven Lakes; near Ironton; Chambers' Lake; Gray's Peak; Front Range, Larimer Co.; South Cottonwood Gulch, Chaffee Co.; Mt. Harvard; Lake City; Empire; Rabbit-Ear Range, Routt Co.

2. TROLLIUS L. GLOBE-FLOWER.

1. *Trollius albiflorus* (A. Gray) Rydb. (*T. laxus albiflorus* Gray) In swamps and along streams from Mont. to Wash., Colo. and Utah.—Alt. 9000-12,000 ft.—Above Beaver Creek; Leroux Park; Cameron Pass; Slide Rock Cañon; Mt. Hesperus, above timber line; Pagosa Peak; Grand Mesa; Graymont; Red Mountain; Marshall Pass; Crystal Lake; headwaters of Clear Creek; Massif de l'Arapahoe.

3. ACTAEA L. BANE-BERRY.

Filaments whitish; raceme short; pedicels in fruit 1-3 cm. long.

Fruit white, ellipsoid, 9-12 mm. long.

Fruit red, spherical or nearly so, 5-7 mm. long.

Filaments greenish; raceme elongated; pedicels very short, even in fruit less than 1 cm. long; fruit red.

1. *A. eburnea*.

2. *A. arguta*.

3. *A. viridiflora*.

1. *Actaea eburnea* Rydb. In rich woods and cañons from Newf. to Alb., Vt. and Utah.—Alt. 8000-10,000 ft.—Mancos; Ouray; Ragged Mountain, Gunnison Co.

2. *Actaea arguta* Nutt. In rich woods and cañons from Mont. to Alaska, Colo. and Calif.—Alt. 8000-10,000 ft.—Mountains above Ouray; Wahatoya Cañon; Black Cañon; Veta Pass; Artists' Glen; near Pike's Peak.

3. *Actaea viridiflora* Greene. In cañons from Colo. to Ariz.—Alt. about 8000 ft.—Four-Mile Hill, Routt Co.; hills west of Ouray; Trapper's Lake.

4. *AQUILEGIA* L. COLUMBINE.

Petals merely saccate, not spurred; terminal leaflet rhombic, acute.

1. *A. Eastwoodiae*.

Petals spurred; all leaflets obtuse.

Lamina of the petals longer than the strongly curved spur; flowers blue; stem low.

2. *A. saximontana*.

Lamina of the petals shorter than the slightly curved or straight spur.

Spur not over 2 cm. long; flowers nodding.

Sepals and spur red.

3. *A. elegantula*.

Whole flower light yellow.

4. *A. micrantha*.

Spur 3-7 cm. long; flowers in anthesis usually erect.

Basal leaves usually twice ternate; spur 3-4 cm. long; sepals blue or white.

5. *A. coerulea*.

Basal leaves usually thrice ternate; spurs 4-7 cm. long; sepals yellow.

Spur 4-5 cm. long; sepals less than 2 cm. long, ovate-lanceolate, acute; follicles strongly curved outward.

6. *A. thalictrifolia*.

Spur 5-7 cm. long; sepals 2-3 cm. long, lanceolate to ovate-lanceolate, acuminate; follicles almost straight.

7. *A. chrysantha*.

1. *Aquilegia Eastwoodiae* Rydb. (*A. ecalcarata* Eastw.; *A. micrantha Mancosana* Eastwood; *A. Mancosana* Cockerell) In dark cañons, Colo.—Johnston Cañon, Mesa Verde.

2. *Aquilegia saximontana* Rydb. (*A. brevistyla* A. Gray; not Hook.) Among rocks, Colo.—Alt. 10,000-12,000 ft.—Cameron Pass; Gray's Peak; headwaters of Clear Creek; Bottomless Pit; Argentine Pass.

3. *Aquilegia elegantula* Greene. (*A. Canadensis* A. Gray, in part) On wooded hillsides in Colo. and N. M.—Alt. 7500-11,000 ft.—Rico; Silverton; Marshall Pass; Slide Rock Cañon; Mancos; about Ouray; Van Boxle's ranch, above Cimarron; Minturn, Eagle Co.; Glenwood Springs; headwaters of Sangre de Cristo Creek; mountain near Veta Pass; West Indian Creek; Lake City.

4. *Aquilegia micrantha* Eastw. In cañons of Colo. and Utah.—Johnston Cañon.

5. *Aquilegia coerulea* James. In woods and on mountain-sides from Mont. to Utah and Colo.—Alt. 6500-12,000 ft.—Vicinity of Como and Como Pass, above timber line; west of Rist Cañon; Beaver Creek; Pennock's mountain ranch; Table Rock; timber line above Graymont; Baxter's ranch; Cameron Pass; Trapper's Lake; Horsetooth Gulch; Horsetooth Mountain; Poudre River; Rist Cañon; Bosworth's; above Beaver Creek; forks of Poudre and Big South; Empire; Mt. Hesperus, above timber line; West Spanish Peak; Bob Creek; below Gray's Peak; Middle Park; mountains near Veta Pass; Sangre de Cristo Creek; North Cheyenne Cañon; Marshall Pass; Mt. Ouray; near Teller, North Park; Pike's Peak; Columbine; Dark Cañon;

North Boulder Peak; headwaters of Clear Creek; Rabbit-Ears, Larimer Co.; Hahn's Peak. [STATE FLOWER OF COLORADO.]

6. *Aquilegia thalictrifolia* Rydb. (*A. chrysantha* Coulter, in part.) In the mountains of Colo. and western Tex.—Alt. 6000-9000 ft.—Alpine Tunnel; Colorado Springs; Bear Creek Cañon; Cañon City; Grand Cañon of the Arkansas.

7. *Aquilegia chrysantha* A. Gray. In the mountains of N. M. and Ariz. It has also been reported from Colo., but no locality given.

5. DELPHINIUM L. LARKSPUR.

Pedicels erect or nearly so.

Sepals white, only tinged with blue; pods over 1 cm. long, about four times as long as broad; seeds squamellate.

Spur almost three times as long as the upper petals, more or less curved; seeds 3 mm. long, black, slightly squamellate. 1. *D. Penardii*.

Spur scarcely twice as long as the upper petals, almost straight; seeds 1.5-2 mm. long, brown, strongly squamellate.

Lobes of the lateral petals divergent; lower pedicels elongated; spur mostly erect. 2. *D. camporum*.

Lobes of the lateral petals not divergent; lower pedicels not elongated; spur mostly horizontal. 3. *D. albescentis*.

Sepals dark blue; pod less than 1 cm. long, only 2-3 times as long as broad; seed not squamellate, but wing-margined; stem and leaves glabrous and glaucous. 12. *D. elongatum*.

Pedicels ascending or spreading.

Inflorescence few-flowered, the lower pedicels elongated; sepals broad, spreading; leaf-segments narrow.

Roots fascicled, thick, but not tuberiform; stem usually viscid, at least above; blades of the lateral petals about 1 cm. long. 4. *D. bicolor*.

Roots tuberiform; stem not viscid; blades of the lateral petals about 5 mm. long.

Flowers dark blue.

5. *D. Nelsonii*.

Flowers light blue.

6. *D. dumetorum*.

Lower pedicels not elongated.

Segments of the basal leaves obtuse, mucronate; flowers light blue.

7. *D. scaposum*.

Segments of all the leaves acute or acuminate.

Plant not at all viscid; follicles pubescent.

Stem grayish strigose throughout.

Leaves divided into cuneate, merely cleft segments.

8. *D. geraniifolium*.

Leaves repeatedly divided into linear division.

Stem 3-5 dm. high; bractlets oblong, close under the calyx.

9. *D. Geyeri*.

Stem 5-20 dm. high; bractlets subulate, 2-3 mm. below the calyx.

11. *D. robustum*.

Stem glabrous and glaucous at least below.

Inflorescence dense; follicles scarcely at all arcuate.

Leaves puberulent; inflorescence stigose.

Leaf-divisions broad, cuneate, merely cleft into lanceolate lobes.

10. *D. cuculatum*.

Leaves repeatedly dissected into linear lobes.

11. *D. robustum*.

Leaves glabrous and glaucous; inflorescence almost glabrous.

12. *D. elongatum*.

Inflorescence lax; follicles strongly arcuate.

13. *D. ramosum*.

Plants more or less viscid, at least the pedicels.

Plant tall, 4-20 dm. high, not caespitose.

Follicles viscid pubescent.

Flowers light blue or yellowish, tinged with blue or purple.

14. *D. multiflorum*.

Flowers dark blue.

15. *D. occidentale*.

Follicles glabrous.

Sepals obtuse.

16. *D. reticulatum*.

Sepals acute or acuminate.

17. *D. Barbeyi*.

Plants about 1 dm. high, caespitose, viscid pubescent.

18. *D. alpestre*.

1. *Delphinium Penardii* Huth. On dry plains of Colo.—Alt. 5000-8000 ft.—Horsetooth Gulch; bank of Arkansas River; Poudre flats, north of Ft. Collins; Ft. Collins; Dixon Cañon; near Badito; Wahatoya Creek; Brantly Cañon, Las Animas Co.

2. *Delphinium camporum* Greene. On dry plains from Colo. to Tex. and Ariz.—Alt. 4000-8000 ft.—Plains and foot-hills near Boulder; New Windsor; near Badito; Walsenburg.

3. *Delphinium albescent* Rydb. In meadows from Ills. to Man., Ind. Terr. and Colo.—Alt. 4000-5000 ft.—Ft. Collins.

4. *Delphinium bicolor* Nutt. Hills and plains from Ass. and Wash. to S. D., Utah and Ore.—Also reported from Colorado; but doubtful.

5. *Delphinium Nelsonii* Greene. On hillsides from Alb. to Wash., Neb. and Utah.—Alt. 4000-10,000 ft.—Four-Mile Hill, Routt Co.; hills west of Soldier Cañon; Horsetooth Gulch; Dolores; Ouray; Howe's Gulch; Rist Cañon; Spring Cañon; Table Rock; Grand Junction; Wyoming State line; Minturn, Eagle Co.; Ft. Collins; foot-hills, Larimer Co.; Chicken Creek; Los Pinos; Van Boxle's ranch, above Cimarron; foot-hills west of Ft. Collins; Mesa Verde; Cerro Summit; Iron-ton; Apex; near Boulder; Steamboat Springs; Beaver Creek, Larimer Co.

6. *Delphinium dumetorum* Greene. In the mountains of Colo.—Alt. about 7000 ft.—Cimarron.

7. *Delphinium scaposum* Greene. On dry plains from Colo. to N. M. and Ariz.—Alt. about 7000 ft.—Mancos.

8. *Delphinium geraniifolium* Rydb. On hills from Colo. and Ariz.—Colorado Springs.

9. *Delphinium Geyeri* Greene. On the plains from Wyo. to Colo.—Alt. 5000-7000 ft.—Foot-hills, Larimer Co.; Rist Cañon; Horsetooth Gulch; hills south of Horsetooth Mountain; plains near Ft. Collins; Livermore, Larimer Co.; New Windsor.

10. *Delphinium cuculatum* A. Nels. On mountain sides from Mont. and Ida. to Colo.—Alt. about 9000 ft.—Four-Mile Hill, Routt Co.

11. *Delphinium robustum* Rydb. In mountain meadows from Mont. to N. M.—Alt. 6000-9000 ft.—Wahatoya Creek; La Veta; Colorado Springs; Indian Creek Pass; foot-hills, Larimer Co.

12. *Delphinium elongatum* Rydb. On hills and mountains of Colo.—Alt. 7000-10,000 ft.—Elk Cañon; Baxter's ranch; foot-hills, Larimer Co.; Villa Grove; alpine ridge east of Middle Park; headwaters of Clear Creek.

13. *Delphinium ramosum* Rydb. In cañons and on mountain sides in Wyo. and Colo.—Alt. 6000-9000 ft.—Crystal Park; Williams' Cañon; Artists' Glen; North Cheyenne Cañon; Idaho Springs.

14. *Delphinium multiflorum* Rydb. On mountain sides from Mont. to Wash. and Colo.—Alt. about 8000 ft.—North Park; Columbine; divide road to Steamboat Springs; Wilson, San Miguel Co.

15. *Delphinium occidentale* S. Wats. (*D. quercetorum* Greene.) On the mountains from Wyo. to Utah and Colo.—Alt. 8000–10,000 ft.—Cerro Summit; Berthoud Pass.

16. *Delphinium reticulatum* (A. Nels.) Rydb. (*Delphinium occidentale reticulatum* A. Nels.) On mountain-sides in Wyo. and Colo.—Mouth of Basin Creek; Upper La Plata Cañon.

17. *Delphinium Barbeyi* Huth. (*D. scopulorum subalpinum* A. Gray; *D. subalpinum* A. Nels.) In shady places in the mountains of Wyo. and Colo.—Alt. 8000–13,000 ft.—Cameron Pass; Boreas; Gray's Peak; Mt. Abram, Ouray; Buffalo Pass; Columbine; near Ironton; Silver Plume; Indian Creek Pass; near Pagosa Peak; Upper La Plata Cañon; Sangre de Cristo Creek; Hinsdale Co.; Empire; Rabbit-Ears, Larimer Co.

18. *Delphinium alpestre* Rydb. On alpine peaks, among rocks, in Colo.—Alt. 10,000–13,000 ft.—Mountain northwest of Como; West Spanish Peak.

6. *ACONITUM* L. MONKHOOD.

Front line of the hood strongly concave, i. e., the beak long, porrect, almost horizontal.

Lower sepals at least $\frac{3}{4}$ as long as the lateral ones; leaf segments rather broad.

1. *A. Bakeri*.

Lower sepals $\frac{1}{2}$ – $\frac{2}{3}$ as long as the lateral ones; leaf segments narrow.

2. *A. porrectum*.

Front line of the hood almost straight, i. e., the beak directed downward.

Lateral sepals very oblique; upper margin semi-reniform.

3. *A. columbianum*.

Lateral sepals moderately oblique; upper margin slightly, if at all, concave.

4. *A. insigne*.

Flowers blue.

Flowers ochroleucous.

5. *A. ochroleucum*.

1. *Aconitum Bakeri* Greene. (*A. atrocyaneum* Rydb.) In the mountains of Colo., Wyo. and Utah.—Alt. 10,000–12,000 ft.—Boreas; Steamboat Springs; gulch west of Bear River; Marshall Pass; Cameron Pass; near Ironton, San Juan Co.

2. *Aconitum porrectum* Rydb. In the mountains of Colo. and Wyo.—Alt. 6000–10,000 ft.—Graymont; Arapahoe Pass; foot-hills, Larimer Co.; Coffee Pot Springs; Columbine; Pike's Peak; North Park; Villa Grove; La Plata Mountains; Lake City; Rabbit-Ears, Larimer Co.

3. *Aconitum columbianum* Nutt. In meadows and open woods from Mont. to B. C., N. M. and Calif.—Alt. 9000–12,000 ft.—Ruxton Park; Ruxton Creek; Pike's Peak; Ouray; Hinsdale Co.

4. *Aconitum insigne* Greene. In the mountains of Colo.—Alt. 7000–11,000 ft.—Bosworth's ranch; Stove Prairie; Beaver Creek; Alpine Tunnel; Parlin, Gunnison Co.; Middle Park; foot-hills, Larimer Co.; Veta Pass; Sangre de Cristo Creek; Central City; La Plata Mountains; near Pagosa Peak; Eldora to Baltimore; Empire.

5. *Aconitum ochroleucum* A. Nels. In the mountains of Colo. and Wyo.—Alt. about 9000 ft.—Indian Creek Pass; Ruxton Park, Pike's Peak; Eldora to Baltimore.

7. ANEMONE L. ANEMONE, WIND-FLOWER.

Achenes densely villous.

Style filiform, usually deciduous; heads of fruit spherical or nearly so; involucre leaves short-petioled.

Leaves ternate; divisions broadly cuneate or flabelliform, crenate or slightly cleft.

Leaves 2-4 times ternate; segments linear to lanceolate.

Styles subulate, persistent; heads of fruit cylindrical; involucre leaves long-petioled.

Achenes not villous.

Flowers cymose; achenes sparingly hirsute when young, sessile; style long, straight.

Flowers subumbellate; achenes glabrous, stipitate; style short, curved.

1. *A. parviflora*.
2. *A. globosa*.
3. *A. cylindrica*.
4. *A. canadensis*.
5. *A. narcissiflora*.

1. *Anemone parviflora* Michx. On exposed mountain tops from Lab. to Alaska, Ont. and Colo.—Alt. about 10,500 ft.—South Cottonwood Gulch, Chaffee Co.

2. *Anemone globosa* Nutt. (*A. multifida* Hook., in part; not Poir.) In meadows and on hillsides from S. D. to Mackenzie River and Alaska, Colo. and Calif.—Alt. 7000-12,000 ft.—Rist Cañon; gulch east of Stove Prairie; Barnes' Camp; forks of Poudre and Big South Rivers; near foot of Rabbit-Ear Range; near Georgetown; Campton's ranch; Carson; Mt. Abram, Ouray; Placer; Iron-ton Park, 9 miles south of Ouray; Veta Pass; Crystal Park; Ruxton Park; Pagosa Springs; Central City; Tennessee Pass; Grizzly Creek; Mt. Harvard; Grayback mining camps; Little Veta Mountains; Caribou; Lake City; Empire; Eldora to Baltimore.

3. *Anemone cylindrica* A. Gray. Among bushes and on hillsides from N. B. to B. C., N. J. and Ariz.—Alt. 4000-8000 ft.—Pennock's; Horsetooth Mountain; foot-hills, Larimer Co.; Dillon Cañon, Trinidad; hills west of Soldier Cañon; Trinidad; La Veta; Wahatoya Creek; Mancos; Pagosa Springs; Piedra.

4. *Anemone canadensis* L. (*A. dichotoma* L.) In river valleys and among bushes from Lab. to Alb., Md. and N. M.—Alt. 4000-9000 ft.—Rist Cañon; Ft. Collins; Table Rock; Poudre Flats; Garland; Sangre de Cristo Creek; New Windsor.

5. *Anemone narcissiflora* L. In the mountains from Alb. to Alaska and Colo.—Alt. 8000-13,000 ft.—Cameron Pass; Beaver Creek; near Teller, North Park; Tennessee Pass; mountains northeast of Boreas; Mt. Harvard; Buffalo Pass; Alpine Tunnel; South Park; summit of North Park Range, Larimer Co.

8. PULSATILLA Adans. PASQUE FLOWER.

1. *Pulsatilla hirsutissima* (Pursh.) Britton. (*Anemone patens Nuttalliana* A. Gray.) On plains and hills from Ills. to Mackenzie, Alb., Tex. and Wash.—Alt. 4000-10,000 ft.—Cameron Pass; foot-hills, Larimer Co.; Clear Creek; Hermosa; Manitou; Crystal Park; about Ouray; mountains near Veta Pass; South Cheyenne Cañon; foot-hills west of Ft. Collins; Horsetooth Gulch; Howe's Gulch; Stove Prairie Hill; Poudre Cañon; Dixon's Cañon; Ojo; Lake City; Pike's Peak; North Boulder Peak; Eldora to Baltimore; Bear Creek Cañon.

9. CLEMATIS L. VIRGIN'S BOWER.

1. *Clematis ligusticifolia* Nutt. Among bushes and in cañons from N. D. to B. C., Mo. and Calif.—Alt. 4000–8000 ft.—Log Cañon; Poudre River, near Ft. Collins; Rist Cañon; Redstone; Narrows; Deer Run; Ft. Collins; near Ouray; Manitou; Cucharas Valley, near La Veta; Piedra; Arkansas Valley; Salida; Durango; plains, Colorado Springs.

10. VIORNA Reichenb. LEATHER-FLOWER, VASE-VINE.

Sepals not at all or very slightly dilated above.

Divisions of the leaves ovate or ovate-lanceolate, 2–5 cm. long. 1. *V. Scottii*.
Divisions of the leaves linear to lanceolate, 1–2 cm. long. 2. *V. Bakeri*.

Sepals conspicuously dilated at the apex.

Sepals acute or short-acuminate; plant in age glabrate; divisions of the leaves lanceolate. 3. *V. Jonesii*.

Sepals obtuse or merely acutish; plant permanently villous; divisions of the leaves linear. 4. *V. eriophora*.

1. *Viorna Scottii* (Porter) Rydb. (*Clematis Scottii* Porter; *C. Douglasii Scottii* Coulter) In open woods and on hillsides from S. D. to Wyo. and N. M.—Alt. 4000–9000 ft.—Vicinity of Dillon Cañon; Trinidad; La Veta; Veta Pass; Poverty Ridge, near Cimarron; Grizzly Creek; La Plata River Valley, near Hesperus Post Office; Cañon City.

2. *Viorna Bakeri* (Greene) Rydb. (*Clematis Bakeri* Greene) In mountains of Colo.—Alt. about 7000 ft.—Los Pinos; Camp Creek, Larimer Co.

3. *Viorna Jonesii* (Kuntze) Rydb. (*Clematis Douglasii Jonesii* Kuntze) On hillsides and in cañons from Colo. to Nev.—Alt. 5000–9000 ft.—Howe's Gulch, near Ft. Collins; vicinity of Ouray; Dolores; Cimarron; Dixon Cañon; foot-hills near Boulder.

4. *Viorna eriophora* Rydb. (*Clematis eriophora* Rydb.) In the foot-hills of Colo., Utah and Wyo.—Alt. 4000–7000 ft.—Foot-hills, Larimer Co.; gulch west of Dixon Cañon; Howe's Gulch; Rist Cañon; Horsetooth Gulch; Ft. Collins; Clear Creek; mesas near Colorado Springs; mountains near Golden City; Pagosa.

11. ATRAGENE L. BELL-RUE, PURPLE VIRGIN'S BOWER.

Leaves merely ternate.

Staminodia usually decidedly spatulate; leaflets toothed or cleft; teeth and apex rounded. 3. *A. diversiloba*.

Staminodia linear or none; leaflets entire or crenate above the middle, long-acuminate. 1. *A. occidentalis*.

Leaves twice or thrice ternate; staminodia linear or lacking.

Secondary leaflets merely toothed or cleft. 2. *A. pseudalpina*.

Secondary leaflets divided to near the base. 4. *A. tenuiloba*.

1. *Atragene occidentalis* Hornem. (*A. Columbiana* Nutt.; *Clematis verticillaris* Coult., in part) In mountain woods from Mont. to B. C., Colo. and Utah.—Alt. 5000–7000 ft.—Foot-hills, Larimer Co.; Howe's Gulch; gulch east of Stove Prairie; Rist Cañon; Baxter's ranch; Ft. Collins; Four-Mile Hill, Routt Co.; Empire; Camp Creek, Larimer Co.

2. *Atragene pseudalpina* (Kuntze) Rydb. (*Clematis alpina occidentalis* A. Gray; not *A. occidentalis* Hornem.) On hillsides, among bushes and in

open woods, in Colo. and N. M.—Alt. 7000–10,000 ft.—Van Boxle's ranch, above Cimarron; Minnehaha; Ojo; hills southeast of La Veta; Veta Pass; Idaho Springs; Mt. Abram, Ouray; chaparral-covered hills southeast of Ouray; Lake City; Cheyenne Cañon.

3. *Atragene diversiloba* Rydb. In mountains of Colo.—Mountains near Denver.

4. *Atragene tenuiloba* (A. Gray) Britton. (*Clematis alpina tenuiloba* A. Gray.) In mountain woods from S. D. to Mont., Colo. and Ariz.—Alt. 7000–10,000 ft.—Placer; Sheep Cañon; North Cheyenne Cañon; Williams' Cañon, above Manitou; Colorado Springs; Pike's Peak.

12. MYOSURUS L. MOUSE-TAIL.

Achenes with a flat back, only slightly carinate and tipped with a very short appressed beak.

1. *M. minimus*.

Achenes strongly carinate on the back, tipped with a long subulate ascending beak.

2. *M. aristatus*.

1. *Myosurus minimus* L. In muddy places and shallow water from Ont. to Wash., Fla. and Calif.; also in Europe and northern Africa.—Alt. up to 5000 ft.—Denver (*Eastwood*).

2. *Myosurus aristatus* Benth. In muddy places from Mont. to Wash., Colo. and Calif.—Alt. up to 9000 ft.—Long's Peak.

13. BATRACHIUM S. F. Gray. WHITE WATER-CROWFOOT.

Petals 5–7 mm. long, broadly obovate; stamens many.

Segments of the leaves 10–15 mm. long, rather rigid, scarcely collapsing when withdrawn from the water.

1. *B. trichophyllum*.

Segments of the leaves 15–30 mm. long, flaccid, collapsing when withdrawn from the water.

2. *B. flaccidum*.

Petals less than 5 mm. long, oblong-obovate; stamens 5–12.

Stem slender; leaves not very flaccid.

3. *B. Drouetii*.

Stem filiform; leaves very flaccid.

4. *B. confervoides*.

1. *Batrachium trichophyllum* (Chaix.) Bosh. (*Ranunculus aquatilis trichophyllum* Chaix.) In water from N. S. to B. C., N. C. and Calif.; also in Mex., Europe and Asia.—Alt. 4000–9000 ft.—Near Ouray; Grizzly Creek; Ft. Collins; Sangre de Cristo Creek; New Windsor; Denver.

2. *Batrachium flaccidum* (Pers.) Rupr. (*Ranunculus aquatilis trichophyllum* A. Gray, in part) In water from Lab. to Wash., N. C. and Low. Calif.—Alt. 4000–10,000 ft.—Ft. Collins; Trail Creek, near junction with North Poudre; Trapper's Lake; below Carson; Upper Laramie River; Boulder.

3. *Batrachium Drouetii* (F. Schultz) Nym. In water from Vt. to Alaska, R. I. and Low. Calif.—Alt. 7000–8000 ft.—Along Uncompahgre River, near Ouray; Parlin, Gunnison Co.; Piedra.

4. *Batrachium confervoides* Fries. In water from Man. to Alaska, south to Colo.—In Grand Lake.

14. RANUNCULUS L. CROWFOOT, BUTTER-CUP.

Leaves linear to oval, entire or merely denticulate or crenate; none divided or cleft.

FLAMMULAE.

Some of the leaves at least cleft.

Sepals black-hairy.

NIVALES.

Sepals not black-hairy.

Some of the basal leaves entire.

GLABERRIMI.

None of the leaves entire.

Plants neither immersed in the water nor creeping in the mud, if rooting at the nodes, not with palmately lobed or dissected leaves.

Achenes turgid, marginless.

Petals much exceeding the sepals.

Basal leaf-blades not divided to the base.

AFFINES.

Basal leaf-blades divided to the base, 2-3 times ternate.

TRITERNATI.

Petals scarcely exceeding the sepals.

ABORTIVI.

Achenes compressed with a distinct margin.

Beak of the achenes distinctly hooked.

RECURVATI.

Beak of the achenes straight or nearly so.

REPENTES.

Plants immersed in the water or creeping in the mud; leaves palmately lobed, divided or dissected.

MULTIFIDI.

FLAMMULAE.

Stem filiform, prostrate, rooting at the nodes.

1. *R. reptans*.

Stem not filiform, erect or ascending, not rooting.

Petals distinctly clawed; beak of the achenes stout.

2. *R. unguiculatus*.

Petals not clawed; beak of the achenes filiform.

3. *R. alismaefolius*.

NIVALES.

Leaf-blades spatulate or elliptic, 2-4-toothed at the apex.

4. *R. Macauleyi*.

GLABERRIMI.

Basal leaf-blades elliptic to oval, usually all entire.

5. *R. ellipticus*.

AFFINES.

Achenes pubescent; heads oblong to cylindric.

Basal leaf-blades or some of them merely crenate; the rest 3-cleft at the apex with a narrow middle lobe.

Petals broadly obovate, about 1 cm. long; sepals densely villous.

6. *R. cardiophyllus*.

Petals oblong-obovate, 3-6 mm. long; sepals not densely villous.

Petals 5-6 mm. long; head of achenes oblong.

7. *R. inamoenus*.

Petals 3-5 mm. long; head of achenes cylindric.

8. *R. micropetalus*.

Basal leaf-blades all digitately or pedately cleft with acute lobes.

9. *R. affinis*.

Achenes glabrous.

Plant glabrous, except the sepals.

Lobes of the stem-leaves elliptic, oval or obovate.

10. *R. Eschscholtzii*.

Lobes of the upper stem-leaves linear to oblong.

Basal leaf-blades orbicular, seldom reniform, seldom cleft more than half-way down; heads of fruit decidedly oblong; stipules semi-circular, about 2 mm. long.

11. *R. alpeophilus*.

Basal leaf-blades decidedly reniform, cleft deeper than half-way down; heads of achenes spherical or nearly so; stipules of the stem-leaves oval, 3-4 mm. long.

12. *R. ochreatus*.

Plant more or less pubescent.

13. *R. ovalis*.

TRITERNATI.

One species.

14. *R. adoneus*.

ABORTIVI.

Basal leaf-blades, at least some of them, merely crenate.

Achenes pubescent; heads of achenes cylindric.

8. *R. micropetalus*.

Achenes glabrous; heads spherical.

Basal leaf-blades cordate at the base; plant glabrous. 15. *R. abortivus*.

Basal leaf-blades rarely cordate at the base; plant hairy.

16. *R. micranthus*.

All the leaf-blades divided or lobed.

Lower leaf-blades less deeply lobed, often not more than half down to the base.

17. *R. sceleratus*.

Leaf-blades all divided to near the base.

18. *R. eremogenes*.

RECURVATI.

Flowers small; petals only 2-5 mm. long.

Stem glabrous.

19. *R. Douglasii*.

Stem hairy; with spreading hairs.

Petals 2-3 mm. long.

20. *R. Bongardii*.

Petals 4-5 mm. long.

21. *R. Earlei*.

Flowers larger; petals 5-10 mm. long; stem appressed-pubescent.

22. *R. acriformis*.

REPENTES.

Heads of achenes oblong, about 5 mm. thick.

23. *R. pennsylvanicus*.

Heads of achenes globose, about 8 mm. thick.

24. *R. Macounii*.

MULTIFIDI.

Leaf-blades deeply cordate at the base; primary divisions lobed or dissected.

25. *R. Purshii*.

Leaf-blades truncate or slightly cordate at the base; primary lobes merely crenate or entire.

26. *R. intertextus*.

1. *Ranunculus reptans* L. (*R. Flammula reptans* E. Meyer) On sandy shores from Lab. to Alaska, N. J., Utah and Ore.—Alt. 5000-10,000 ft.—Vicinity of Como; bank of Michigan, North Park; Trapper's Lake; plains and foot-hills near Boulder; Ward; Gunnison; Parlin; Twin Lakes; Steamboat Springs.

2. *Ranunculus unguiculatus* Greene. In wet places in the mountains of Colo.—Alt. 9000-12,000 ft.—Grand Mesa; Buffalo Pass; near Pagosa Peak; Deep Creek Lake, Garfield Co.; Rabbit-Ear Range, Routt Co.; Beaver Creek.

3. *Ranunculus alismaefolius* Geyer. (*R. calthaefolius* Greene) In wet places from Wyo. to Nev., Colo., Utah and Ore.—Alt. 10,000-12,000 ft.—Deep Creek Lake; Bear Creek Divide; Cameron Pass; Tennessee Pass; Golden; Berthoud Pass; headwaters of Clear Creek; alpine ridges east of Middle Park.

4. *Ranunculus Macauleyi* A. Gray. In wet places, among rocks, on alpine peaks of Colo.—Alt. 10,000-12,000 ft.—Red Mountain; Carson; Pagosa Peak; West Spanish Peak; Bear Creek Divide; Hinsdale Co.

5. *Ranunculus ellipticus* Greene. (*R. glaberrimus* Coulter, in part.) In wet places from Mont. to B. C., Colo. and Calif.—Alt. 5000-12,000 ft.—Rist. Cañon; foot-hills, Larimer Co.; gulch west of Bellone; Dixon Cañon; foot of Horsetooth Mountain; Ft. Collins; Berthoud Pass.

6. *Ranunculus cardiophyllus* Hook. (*R. affinis cardiophyllus* A. Gray) In wet meadows and bogs from Sask. to Colo.—Alt. 5000-10,000 ft.—Table Rock; gulch east of Stove Prairie; Campton's ranch, 12 miles below Grand Lake; Veta Pass; Twin Lakes; Tennessee Pass; Graham's Peak; divide between Colorado Springs and Denver; Eldora to Baltimore.

7. *Ranunculus inamoenus* Greene. In meadows and along streams from Mont. to N. M. and Utah.—Alt. 7000–10,000 ft.—Silverton; Boreas; Mancos; Breckenridge; Bob Creek; Veta Mountain; Cucharas River, above La Veta; Manitou; headwaters of Sangre de Cristo Creek; Los Pinos; West Indian Creek; Palsgrove Cañon; Grand Mesa; Caribou; Berthoud Pass; Eldora to Baltimore; Rabbit-Ear Range, Routt Co.

8. *Ranunculus micropetalus* (Greene) Rydb. (*R. affinis micropetalus* Greene) In wet meadows and along streams from Colo. to Utah and Ariz.—Alt. 7000–11,000 ft.—Rico; Silverton; gulch east of Stove Prairie; Rabbit-Ear Pass; Chambers' Lake; Ironton Park, 9 miles south of Ouray; headwaters of Sangre de Cristo Creek; Iron Mountain; Cucharas Valley, near La Veta; West Spanish Peak.

9. *Ranunculus affinis* R. Br. In alpine bogs and meadows from Sask. to Alaska and Colo.—Alt. 7000–12,000 ft.—Stove Prairie Hill; Boreas; West Indian Creek; Eldora to Baltimore.

10. *Ranunculus Eschscholtzii* Schlecht. In wet alpine or subarctic localities from Wyo. to Alaska, Colo., Nev. and Wash.—Mt. Hesperus, at timber line; Mt. Barrett.

11. *Ranunculus alpeophilus* A. Nels. In wet places near the snow from Mont. to Colo.—Alt. 9000–12,000 ft.—Boreas; Trapper's Lake; Beaver Creek; Mt. Abram, Ouray; Alpine Tunnel; Tennessee Pass; Caribou; Berthoud Pass.

12. *Ranunculus ocreatus* Greene. In wet places on alpine peaks in Colo.—Head of Leroux Creek, Delta Co.; Mt. Hesperus, at timber line; Mt. Abram, Ouray.

13. *Ranunculus ovalis* Raf. (*R. rhomboides* Goldie.) In meadows from Lab. to Athabaska, Que. and Colo.—Alt. 4000–7500 ft.—Stove Prairie Hill; Table Rock; Cherry Creek, El Paso Co.

14. *Ranunculus adoneus* A. Gray. On alpine peaks from Wyo. to Colo. and Utah.—Alt. 10,000–12,000 ft.—Mountains about Graymont; above Beaver Creek; above timber line, West Como Pass; Berthoud Pass; Georgetown; south fork of Cache la Poudre River; Cameron Pass; Ward, Boulder Co.; Spicer, Larimer Co.

15. *Ranunculus abortivus* L. In woods and wet grounds from Lab. to Sask., Fla. and Colo.—Alt. 4000–8000 ft.—Rist Cañon; Pennock's mountain ranch; Walton Creek; Victoria; Clear Creek; Cucharas Valley, near La Veta; Cascade; Ft. Collins; Cameron Pass; Steamboat Springs.

16. *Ranunculus micranthus* Nutt. In rich woods from Mass. to Sask., Pa. and Colo.—Twin Lakes.

17. *Ranunculus sceleratus* L. In swamps and ditches from N. B. to Wyo., Fla. and Colo.—Villa Grove.

18. *Ranunculus eremogenes* Greene. In swamps and on lake shores from Sask. to Alb., N. M. and Calif.—Alt. 4000–8000 ft.—Poudre, near La Porte; Ft. Collins; Montrose; Placer; near Boulder; Gunnison; Black Cañon; New Windsor; Arboles; Cucharas Valley, near La Veta.

19. *Ranunculus Douglasii* Howell. (*R. tenellus* Nutt.; not Viv.) On river banks and wet meadows from Mont. to Alaska, Colo. and Calif.—Alt. about 8500 ft.—Leroux Creek, Delta Co.

20. *Ranunculus Bongardii* Greene. (*R. tenellus Lyallii* A. Gray) Along streams from Mont. to Alaska, Colo. and Ore.—Near Wyoming line, North Park.

21. *Ranunculus Earlei* Greene. Along mountain streams in Colo.—Alt. up to 10,000 ft.—Gore Pass; Leroux Creek; Hotchkiss, Delta Co.; Mancos; Bob Creek.

22. *Ranunculus acriformis* A. Gray. Along streams in Wyo. and northern Colo.—Alt. up to 9000 ft.—Laramie River.

23. *Ranunculus pennsylvanicus* L. f. On river banks from N. S. to Ida, Ga. and Colo.—Alamosa.

24. *Ranunculus Macounii* Britton. Along streams and in wet places from Ont. to Alb., Iowa and Colo.—Alt. 4000–8000 ft.—Ft. Collins; Bear River; Steamboat Springs; Durango; bank of Michigan, Walden; New Windsor; Gunnison; Mancos; Middle Park; La Veta; Kremmling; Cucharas Valley, near La Veta; Routt Co.

25. *Ranunculus Purshii* Richardson. (*R. multifidus* Coult., in part) In water and on muddy flats from N. S. to Alaska, Ont., Colo. and Ore.—Alt. 4000–10,000 ft.—Laramie River; above Beaver Creek; Ft. Collins; bank of Michigan, at Walden; Front Range, Larimer Co.; Wahatoya Creek; Parlin, Gunnison Co.; stream 12 miles below Grand Lake; Gunnison.

26. *Ranunculus intertextus* Greene. (*R. hyperboreus natans* Coult.; not Regel; *R. natans* A. Gray; not Meyer) In water in Wyo. and Colo.—Alt. 8000–10,000 ft.—Vicinity of Como; Graymont; Georgetown; Breckenridge; Cassell's; South Park; Empire City.

15. HALERPESTES Greene.

1. *Halerpestes Cymbalaria* (Pursh) Greene. (*Ranunculus Cymbalaria* Pursh; *Oxygraphis Cymbalaria* Prantl) In wet and especially alkaline soil from Lab. to Alaska, N. J. and Calif.—Alt. 4000–10,000 ft.—Ft. Collins; Pueblo; Gypsum; Trail Creek; Graymont; Colorado Springs; Montrose; Grizzly Creek; Durango; Arboles; Sangre de Cristo Creek; Walsenburg; Parlin; Ouray; Palsgrove Cañon.

16. CYRTORRHYNCHA Nutt.

Sepals broadly rounded-ovate, not clawed; petals usually wanting.

1. *C. neglecta*.

Sepals spatulate or obovate, clawed; petals usually present.

Leaf segments thick, mostly acute; panicle corymbiform.

2. *C. ranunculina*.

Leaf segments thin, broad; inflorescence not corymbiform.

3. *C. rupestris*.

1. *Cyrtorrhyncha neglecta* Greene. In the mountains of Colo.—Horsetooth Mountain; Golden City.

2. *Cyrtorrhyncha ranunculina* Nutt. In the mountains of Wyo. and Colo.—Alt. 6000–8000 ft.—Hills west of Soldier Cañon; Rist Cañon; foot-hills, Ft. Collins; Howe's Gulch, Larimer Co.; Spring Cañon; Horsetooth Mountain; Dixon Cañon; Green Mountain Falls; Ohio Creek.

3. *Cyrtorrhyncha rupestris* Greene. In the mountains of Colorado.—Black Cañon.

17. **THALICTRUM** L. MEADOW-RUE.

Flowers perfect.

Plant 2 dm. or less high; achenes turgid; filaments filiform. 1. *T. alpinum*.

Plant 3-10 dm. high; achenes flat and very oblique; filaments clavate.

2. *T. sparsiflorum*.

Flowers dioecious or polygamous.

Achenes turgid, thick-walled; ribs thick and almost corky, separated by acute grooves.

Plants polygamous; stem-leaves subsessile.

Achenes, petioles and lower surface of the leaves decidedly viscid-pubescent.

3. *T. dasycarpum*.

Achenes, petioles and the lower surface of the leaves glabrous or slightly viscid-puberulent.

4. *T. purpurascens*.

Plants dioecious; stem-leaves petioled.

5. *T. venulosum*.

Achenes more or less flattened, thin-walled; ribs not thick, separated by wide shallow rounded grooves; achenes not twice as long as broad, decidedly oblique.

6. *T. Fendleri*.

1. *Thalictrum alpinum* L. In alpine and arctic bogs from Greenl. to Alaska, Colo. and Calif.—Alt. 9000-12,000 ft.—Como; Alpine Tunnel; Seven Lakes; Tennessee Pass; near Wyoming line, North Park; Hamor's Lake, above Durango; West Indian Creek; Pike's Peak; headwaters of Clear Creek; alpine ridges east of Middle Park.

2. *Thalictrum sparsiflorum* Turcz. In wet ground from Mont. to Alaska, Colo. and Calif.—Alt. 6000-8500 ft.—Happy Hollow; near Georgetown; Carleton Lake; Parlin; Long Gulch, Larimer Co.; Minnehaha; headwaters of Clear Creek; Empire.

3. *Thalictrum dasycarpum* Fisch. & Lall. In wet meadows from Ont. to Sask. and Colo.—Alt. 4000-8000 ft.—Ft. Collins; La Veta; New Windsor; bank of river, Larimer Co.; Wahatoya Creek; Pagosa Springs; Walsenburg.

4. *Thalictrum purpurascens* L. (*T. Cornuti* Torr., in part; not L.) In wet meadows from N. S. to Sask., Fla. and Colo.—Alt. 4000-6000 ft.—Along the Poudre; Ft. Collins and La Porte; plains and foot-hills near Boulder.

5. *Thalictrum venulosum* Trelease. On hills and in open woods from Man. to B. C. and Colo.—Alt. 5000-12,000 ft.—Dillon Cañon; Cache la Poudre; Gunnison; Estes Park; Cumberland Mine, La Plata Mountains.

6. *Thalictrum Fendleri* Engelm. In the mountains from Wyo. to N. M. and Ariz.—Alt. 6000-10,000 ft.—Foot-hills, Larimer Co.; Dillon Cañon, Trinidad; gulch west of Penneck's; Livermore; Steamboat Springs; Four-Mile Hill, Routt Co.; vicinity of Ouray; Villa Grove; Ute Pass; Dillon; foot of Pike's Peak; Veta Pass; West Indian Creek; North Cheyenne Cañon; Mancos; Silver Plume; Idaho Springs; Arboles; Pagosa Peak; Chicken Creek; Bob Creek; Colorado Springs; Turkey Creek; Sangre de Cristo Creek; Eldora to Baltimore.

Family 55. **NYMPHAEACEAE** DC. WATER-LILY FAMILY.

1. **NYMPHAEA** L. YELLOW WATER-LILY.

1. *Nymphaea polysepala* (Engelm.) Greene. In lakes and slow streams from Mont. to Alaska, Colo. to Calif.—Alt. up to 11,000 ft.—Chambers' Lake; Bierstadt Lake.

Family 56. **BERBERIDACEAE.** BARBERRY FAMILY.

Primary leaves of the shoots reduced to spines; in their axils short branches with secondary, unifoliate leaves.

Primary leaves of the shoots pinnate; no spines.

1. **BERBERIS.**2. **ODOSTEMON.**1. **BERBERIS** L. BARBERRY.

1. *Berberis Fendleri* A. Gray. In the mountains of Colo. and N. M.—Alt. 6000-7000 ft.—Durango; Mancos; Arboles; Mancos Cañon.

2. **ODOSTEMON** Raf. OREGON GRAPES.

Fruit becoming dry and inflated at maturity; leaflets less than 3 cm. long; shrub .15-36 dm. high.

Fruit fleshy, not inflated at maturity; leaflets 3-6 cm. long; shrub prostrate, 1-3 dm. high.

1. *O. Fremontii.*2. *O. Aquifolium.*

1. *Odostemon Fremontii* (Torr.) Rydb. (*Berberis Fremontii* Torr.) In the mountains of Colo., Utah, N. M. and Ariz.—Smith Fork Cañon, Delta Co.

2. *Odostemon Aquifolium* (Pursh) Rydb. (*Berberis Aquifolium* Pursh; *B. repens* Lindl.) On hills from Mont. and Ida. to N. M. and Calif.—Alt. 4000-10,000 ft.—Vicinity of Horsetooth; Horsetooth Gulch; Rist Cañon; Clear Creek Cañon, above Golden; Platte Cañon; Ouray; Snake River; hills south-east of La Veta; East Indian Creek; Veta Mountain; cañon of La Plata River; foot-hills, Larimer Co.; about Ouray; Lake City; near Boulder.

Order 26. **PAPAVERALES.**

Sepals 2 or 3; endosperm present.

Flowers regular; stamens in ours numerous.

57. **PAPAVERACEAE.**

Flowers irregular; stamens 6, diadelphous.

58. **FUMARIACEAE.**

Sepals 4, rarely more; endosperm wanting.

Capsule 2-celled; stamens 6, tetradynamous, rarely 2 or 4.

59. **BRASSICACEAE.**

Capsule 1-celled; stamens not tetradynamous, 6 or more.

60. **CAPPARIDACEAE.**Family 57. **PAPAVERACEAE** Juss. POPPY FAMILY.

Capsule opening by many dentiform lids under the stigma; placentae ceptiform.

1. **PAPAV.**

Capsule opening by 4-6 valves at the summit; placentae nerviform.

2. **ARGEMONE.**1. **PAPAV** L. POPPY.

1. *Papaver radicatum* Rottb. (*P. alpinum* and *P. nudicaule* A. Gray; not L.) In arctic regions and on alpine mountain tops from Greenl. and Lab. to Alaska and in Colo.; also in Europe.—Alt. 13,000-14,000 ft.—Gray's Peak.

2. **ARGEMONE** L. PRICKLY POPPY.

Corolla yellow.

1. *A. mexicana.*

Corolla white.

Stem unarmed or prickly, but not hispid pubescent.

2. *A. intermedia.*

Stem hispid pubescent as well as spiny; leaf-blades deeply and usually doubly lobed.

3. *A. hispida.*

1. *Argemone mexicana* L. Introduced from Mexico and sparingly established from N. J. to Fla. and N. M. It has been reported from Colorado, but doubtful.

2. *Argemone intermedia* Sweet. (*A. platyceras* Coult., in part) In sandy soil, on the plains and in the foot-hills, in cañons and draws from S. D. to Wyo., Tex. and Mex.—Alt. 4000-7500 ft.—Dixon Cañon; Spring Cañon; Trinidad; Manitou; Black Cañon; plains and foot-hills near Boulder; New Windsor; Ft. Collins.

3. *Argemone hispida* A. Gray. (*A. bipinnatifida* Greene) On sandy soil, on the plains and in the foot-hills, from Wyo. to Utah and N. M.—Alt. 4500-9000 ft.—Ft. Collins; along Platte River, Denver; Huerfano Valley, near Gardner; Veta Pass; west of New Windsor; foot-hills, Colorado Springs; plains and foot-hills near Boulder; Redcliffe.

Family 58. FUMARIACEAE. FUMITORY FAMILY.

Capsule 2-valved, several-seeded.
Fruit globose, indehiscent, 1-seeded.

1. CAPNOIDES.
2. FUMARIA.

1. CAPNOIDES Adans. CORYDALIS.

Annual or biennial; corolla yellow.

Bracts narrowly lanceolate; pod torulose, pedulous.

Bracts ovate-lanceolate, ovate or obovate; pod erect on curved pedicels, not torulose.

Perennials with thickened roots; corolla white or tinged with purple.

1. *C. aureum*.
2. *C. montanum*.
3. *C. Brandegei*.

1. *Capnoides aureum* (Willd.) Kuntze. (*Corydalis aurea* Willd.) Among bushes, in open woods and on hillsides, from N. S. to Alaska, Pa. and Calif.—Alt. 4000-10,000 ft.—Dillon Cañon, Trinidad; above Beaver Creek; Platte River Valley; Stove Prairie Hill; Trail Creek; near Boulder; mountains between Sunshine and Ward; Engelmann Cañon; Ouray; Villa Grove; Georgetown; river bank near Ft. Collins; West Indian Creek; Green Mountain Falls; Cucharas Valley, near La Veta; South Park; Manitou; West Mancos Cañon; Ward, Boulder Co.; Sapinero; Minnehaha; Marshall Pass; Pike's Peak; mountain sides near Empire; Ute Pass; Walden, Larimer Co.

2. *Capnoides montanum* (Engelm.) Britton. (*Corydalis aurea occidentalis* A. Gray; *Capnoides pachylobum* Greene) On river banks and in cañons from S. D. to Utah, Tex. and Ariz.—Alt. 4000-8000 ft.—Trinidad; gulch west of Soldier Cañon; Horsetooth Gulch; foot-hills of Larimer Co.; Howe's Gulch; Los Pinos; hills southeast of La Veta; Arboles; near Boulder; Rist Cañon; Spring Cañon; Poudre flats; Trinidad; Manitou; mountains between Sunshine and Ward; New Windsor; Upper West Mancos Cañon.

3. *Capnoides Brandegei* (S. Wats.) Heller. (*Corydalis Brandegei* S. Wats.) In the mountains of Colo. and Utah.—Alt. 9000-10,000 ft.—Leroux Creek; Crystal Creek; Ruby; near Pagosa Peak; Piedra Mountains.

2. FUMARIA L. FUMITORY.

1. *Fumaria officinalis* L. Introduced from Europe and established locally from N. S. to Fla., Colo. and Tex.—Ft. Collins.

Family 59. **BRASSIACEAE** Lind. **MUSTARD FAMILY.**

- I. Pods sessile or short-stipitate (in two species of *Thelypodium*); sepals erect or connivent in anthesis; anthers not twisted (except in *Thelypodium*).
- A. Pods compressed or flattened contrary to the narrow partition.
- Pods not didymous; plants not densely stellate, except in *Smelowskya*.
- Pods orbicular, oval or cuneate, strongly flattened; plant not stellate.
- Cells of the pod 1-seeded.
- Pods ovate-cordate, acute at the apex, neither winged nor retuse.
1. *CARDARIA*.
- Pods orbicular, elliptic or rarely ovate, retuse or notched at the apex, usually winged.
2. *LEPIDIUM*.
- Cells of the pods 2-seeded.
- Pods more or less winged; cotyledons accumbent; hairs of the plant simple or none.
3. *THLASPI*.
- Pods cuneate, wingless; cotyledons incumbent; plants with branched hairs.
4. *BURSA*.
- Pods ovate or lanceolate, not strongly flattened; plant stellate.
5. *SMELOWSKYA*.
- Pods more or less didymous; plants stellate.
- Seeds solitary in each cell; pods strongly flattened.
6. *DITHYREA*.
- Seeds several in each cell; pods more or less inflated.
7. *PHYSARIA*.
- B. Pods neither compressed nor flattened contrary to the partition.
1. Anthers not sagittate at the base.
- a. Pods terete or tetragonal.
- Pods short, scarcely more than twice as long as broad, or less.
- Cotyledons accumbent; valves of the pods nerveless.
- Pubescence stellate; seeds flat.
8. *LESQUERELLA*.
- Pubescence not stellate; seeds terete.
10. *RORIPA*.
- Cotyledons incumbent or folded transversely; valves of the pod 1-nerved; pubescence not densely stellate.
9. *CAMELINA*.
- Pods long, several times as long as broad.
- Pods scarcely beaked, merely tipped by a short style or a sessile stigma.
- Pods terete or nearly so.
- Seeds in two rows in each cell of the pod.
- Valves of the pod nerveless; seeds globose or oblong, turgid; cotyledons accumbent.
10. *RORIPA*.
- Valves of the pods 1-nerved; cotyledons at least partly incumbent.
- Seeds flattened; leaves entire or toothed.
11. *TURRITIS*.
- Seeds turgid; leaves pinnatifid.
13. *SOPHIA*.
- Seeds in one row in each cell of the pod.
- Glabrous perennials with creeping rootstocks.
12. *SCHOENOCRAMBE*.
- More or less hairy annuals or perennials with tap-roots.
- Pubescence of simple hairs; leaves runcinate or entire.
- 12a. *SISYMBRIUM*.
- Pubescence of forked hairs; leaves pinnately dissected.
13. *SOPHIA*.
- Pods 4-angled.
- Stem leaves clasping by a cordate base.
23. *CONRINGIA*.
- Stem leaves not clasping.
- Corolla white.
14. *STENOPHRAGMA*.
- Corolla yellow.
- Seeds plump; leaf-blades entire or toothed.
15. *ERYSIMUM*.
- Seeds flat; leaf-blades pinnatifid.
16. *BARBAREA*.
- Pod with a long distinct beak.
- Beak flat and sword-like.
17. *SINAPIS*.
- Beak elongated, conic or 4-angled.
18. *BRASSICA*.
- b. Pod flattened parallel to the broad partition.

- Pod orbicular; valves convex, with flattened margins; filaments dilated and toothed near the base. 19. *ALLYSSUM*.
- Pod oblong, ovate or linear, rarely nearly orbicular; valves flat, or if convex not with flattened margins; filaments unappendaged.
- Valves nerveless.
- Valves not elastically dehiscent; seeds in two rows; pod usually short. 20. *DRABA*.
- Valves elastically dehiscent; seeds in one row; pod long. 21. *CARDAMINE*.
- Valves nerved and reticulate, not elastically dehiscent.
- Pod short, from orbicular to linear-oblong. 20. *DRABA*.
- Pods elongated-linear.
- Cotyledons accumbent. 22. *ARABIS*.
- Cotyledons incumbent. 23. *CONRINGIA*.
2. Anthers sagittate at the base.
- Calyx campanulate, open; petals ample.
- Pod flat. 24. *STREPTANTHUS*.
- Pod terete or tetragonal. 26. *THELYPODIUM*.
- Calyx urn-shaped, closed; blades of the petals narrow, undulate-crisp. 25. *EUKLISIA*.
27. *STANLEYA*.
- II. Pod terete long-stipitate; sepals spreading in anthesis; anthers curved and spirally twisted.

1. *CARDARIA* Desv.

1. *Cardaria Draba* (L.) Desv. (*Lepidium Draba* L.) Introduced from Europe; in waste places from Wyo. to Colo. and Calif.—Alt. 4000–5000 ft.—Palisades; Grand Junction; near Boulder.

2. *LEPIDIUM* L. PEPPER-GRASS.

Style evident, at least equalling the wing-margins of the fruit.

None of the leaves pinnatifid.

Blades of the basal leaves truncate and 3-toothed at the apex.

Blades of the basal leaves acute, serrate or crenate.

Basal leaves at least pinnatifid.

Segments of the basal leaves short obovate or broadly oblanceolate in outline.

Segments of the basal leaves elongated, linear, oblong or lanceolate.

Only the lowest leaves pinnatifid; pod broadly oval; style scarcely longer than the width of the wing-margin.

Lower stem-leaves also pinnatifid; pod narrower, acutish at both ends; style about twice as long as the wing-margin.

Plant low, 3 dm. high or less; leaves or their lobes narrowly linear.

Plant tall, 4–8 dm. high; upper leaves broadly linear or oblong.

Style obsolete, at least much shorter than the wing-margin of the fruit, or stigma subsessile.

Petals conspicuous, at least equalling the sepals, spatulate or obovate.

Blades of the petals broadly obovate, much exceeding the sepals; style short.

Blades of the petals spatulate; style none.

Cotyledons accumbent; petals broadly spatulate.

Cotyledons incumbent; petals narrowly spatulate.

Stem glabrous or nearly so; petals well exceeding the sepal.

Stem glandular puberulent; petals about equalling the sepal.

10. *L. ramosum*.

Petals none or minute, scarcely more than half as long as the sepals, linear or linear-spatulate.

Plant branched at the base; petals often present.

Axillary racemes very short and dense, usually shorter than the leaves; petals more than half as long as the sepals. 11. *L. ramosissimum*.

Axillary racemes at last elongated; petals very minute or none.

12. *L. divergens*.

Plant simple below, branched above; petals none; racemes elongated.

13. *L. densiflorum*.

1. *Lepidium spathulatum* (Robinson) Vasey. (*L. scopulorum spathulatum* Robinson) In the mountains of Colo.—Between Meeker and Craig; headwaters of Bear Creek.

2. *Lepidium crenatum* (Greene) Rydb. (*Thelypodium crenatum* Greene) In river valleys of Colo. and Utah.—Paonia; Mancos.

3. *Lepidium montanum* Nutt. In mountain valleys and on plains from Wyo. to Wash., Colo. and Ariz.; also in Mex.—Alt. 7000-10,000 ft.—Pitkin; Lake City.

4. *Lepidium alyssoides* A. Gray. In river valleys from Colo. to Tex. and Ariz.; also in Mex.—Alt. 5000-8000 ft.—Grand Junction; Conejos River, north of Antonito; Alamosa.

5. *Lepidium Jonesii* Rydb. In mountain valleys of Colo. and Utah.—Alt. 4000-7000 ft.—Palisades; Grand Junction; Spring Cañon; Montrose.

6. *Lepidium Eastwoodiae* Wooton. In river valleys of Colo. and N. M.—Alt. 5000-9000 ft.—Glenwood Springs; Sangre de Cristo Creek; Pueblo Co.

7. *Lepidium idahoense* Heller. In sandy river valley in Ida. and Colo.—Alt. up to 7000 ft.—South of Horsetooth Mountain; Spring Cañon; foot-hills, Larimer Co.

8. *Lepidium virginicum* L. In waste places from Que. to Minn., Fla. and Tex.—Alt. 7000-10,000 ft.—Along the Conejos River, north of Antonito; Horsetooth Gulch; near Pagosa Peak.

9. *Lepidium medium* Greene. In waste places and on sandy soil from Mo. to Tex. and Calif.—Alt. 5000-7000 ft.—Grand Junction; gulch west of Pen-nock's; Reno; Larimer Co.; plains and foot-hills near Boulder; Lower Boulder Cañon.

10. *Lepidium ramosum* A. Nels. In arid soil from S. D. to Wyo., Colo. and Utah.—Alt. up to 10,000 ft.—Vicinity of Como; Wolcott, Eagle Co.

11. *Lepidium ramosissimum* A. Nels. In arid soil from Neb. to Wyo. and Colo.—Alt. 4000-9000 ft.—Pitkin; plains, Colorado Springs.

12. *Lepidium divergens* Osterh. In the mountains of Colo.—Tennessee Pass.

13. *Lepidium densiflorum* Schrad. (*L. apetalum* Aschers.; not Willd.; *L. intermedium* A. Gray) In waste places and sandy soil from Me. to Alb., DC. and Calif.—Alt. 4000-9000 ft.—Quimby; Ft. Collins; New Windsor, Weld Co.; plains, Larimer Co.; Arboles; chaparral-covered hills southeast of Ouray; Dix.

3. *THLASPI* L. PENNY-GRASS.

Pod orbicular in outline, broadly wing-margined and deeply notched at the apex.

1. *T. arvense*.

Pods obovate or cuneate in outline, with narrow margins, truncate or slightly notched at the apex.

Pods emarginate; sinus narrow.

Rootstock rather slender; stem 1-2 dm. high; petals spatulate, about 5 mm. long.

2. *T. Nuttallii*.

Rootstock stout, densely caespitose; stems less than 1 dm. high; petals broadly obovate, 6-7 mm. long.

3. *T. coloradense*.

Pods truncate or nearly so at the apex; sinus broad and open.

Stem 2-3 dm. high; stem-leaves ample, broader than the basal ones; sepals green.

4. *T. glaucum*.

Stems 1 dm. high or less; stem-leaves reduced; sepals and often also petals purplish.

5. *T. purpurascens*.

1. *Thlaspi arvense* L. In waste places from Lab. to B. C., N. Y. and Colo. Introduced from Europe.—Alt. 5000-10,000 ft.—Quimby; Silverton; plains and foot-hills near Boulder; Pass Creek.

2. *Thlaspi Nuttallii* Rydb. (*T. cochleariforme* Nutt.; not DC.) Among rocks in the mountains from Mont. to Wash. and Colo.—Alt. 8000-12,000 ft.—Dead Lake; Minturn, Eagle Co.; Bob Creek; banks of Michigan Creek, near Teller; North Park.

3. *Thlaspi coloradense* Rydb. In wet places, among rocks, on the peaks, in Colo.—Alt. 6000-14,400 ft.—Foot-hills, Larimer Co.; Gray's Peak; along Beaver Creek; above timber line, west of Cameron Pass; Sierra Blanca; summit of Pike's Peak; Grand Mesa; west slope of Bald Mountain; Clear Creek; Red Mountain, south of Ouray; Seven Lakes; Los Pinos; Tennessee Pass; Cheyenne Mountain; West Spanish Peak; South Cheyenne Cañon; Massif de l'Arapahoe; Spicer, Larimer Co.

4. *Thlaspi glaucum* A. Nels. In mountain valleys and cañons from Ida. to Colo. and Utah.—Alt. 8000-13,000 ft.—Spring Cañon; Red Mountain; Pike's Peak Valley; Silver Plume; Gray's Peak; Bob Creek; Cameron Pass; Pass Creek; near Ironton, San Juan Co.; Rabbit-Ears, Larimer Co.

5. *Thlaspi purpurascens* Rydb. Among rocks, on the peaks of Colo. and Ariz.—Alt. 7000-14,300 ft.—Gray's Peak; Cimarron; Spring Cañon; Horsetooth Gulch; gulch west of Dixon Cañon; Rist Cañon; Table Rock; Front Range, Larimer Co.; Dixon Cañon; headwaters of Sangre de Cristo Creek; Iron Mountain; Eldora to Baltimore.

4. BURSA Weber. SHEPHERD'S PURSE.

1. *Bursa Bursa-pastoris* (L.) Britton. In waste places and fields from Lab. to Wash. and Calif.—Alt. 4000-9000 ft.—Quimby; Table Rock; Ft. Collins; hills about Box Cañon, west of Ouray; Sangre de Cristo Creek; Mancos.

5. SMELOWSKIA.

Segments of basal leaves spatulate.

1. *S. americana*.

Segments of the basal leaves linear or linear-oblong.

2. *S. lineariloba*.

1. *Smelowskia americana* Rydb. (*S. calycina* B. & H.; not C. A. Mey.) On the higher mountain tops from Mont. to Colo. and Nev.—Alt. 10,000-12,000 ft.—Cumberland Basin, La Plata Mountains; Devil's Causeway; mountain northwest of Como; Ragged Mountain, Gunnison Co.; Mt. Abram, Ouray.

2. *Smelowskia lineariloba* Rydb. On alpine peaks of Colo.—Alt. 12,000-14,000 ft.—Douglass Mountain; Georgetown; Silver Plume; northwest of Como; near Ironton, San Juan Co.; Mt. Bartlett, Robinson.

6. DITHYREA Harv.

1. *Dithyrea Wislizeni* Engelm. In dry regions from Tex. and Colo. to Utah and Ariz.—Alt. 4500–6000 ft.—Valley of the San Juan (*Brandegee*).

7. PHYSARIA A. Gray. DOUBLE BLADDER-POD.

Pods deeply cordate at the base; lower sinus almost as deep as the upper.

1. *P. didymocarpa*.

Pods not cordate at the base or slightly so; lower sinus none or very shallow.

Basal leaves or at least some of them more or less fiddle-shaped.

Leaves of the decumbent flowering stems reduced; terminal lobe of the basal leaves rounded or reniform, very obtuse, entire.

2. *P. vitulifera*.

Leaves of the ascending flowering stems ample; terminal lobe of the basal leaves rhombic or ovate, obtuse or acute, sinuate.

3. *P. floribunda*.

Basal leaves oblanceolate or spatulate, acute, not fiddle-shaped, 2–4 cm. long.

4. *P. acutifolia*.

1. *Physaria didymocarpa* (Hook.) A. Gray. On dry hills from Sask. and Alb. to Colo. and Utah.—Alt. 5000–7000 ft.—Bluffs north of La Porte; Ft. Collins; Ruxton; Durango; Mancos.

2. *Physaria vitulifera* Rydb. In mountain valleys and cañons of Colo.—Alt. 8000–10,000 ft.—Palisades; Idaho Springs; Grand Junction; headwaters of Clear Creek; alpine ridges east of Middle Park; Bear Creek Cañon.

3. *Physaria floribunda* Rydb. In mountain valleys of Colo.—Alt. 5000–9000 ft.—Plains and foot-hills near Boulder; Wolcott; Veta Pass; Golden, Jefferson Co.; Cimarron; Sangre de Cristo Creek; Clear Creek Cañon; Hotchkiss; Eldora to Baltimore.

4. *Physaria acutifolia* Rydb. On dry hills in Wyo. and Colo.—Alt. 5000–10,500 ft.—Grand Junction; Ruxton Ridge; North Cheyenne Cañon; Steamboat Springs.

8. LESQUERELLA S. Wats. BLADDER-POD.

Ovary and pod stellate-pubescent.

Pods ovoid or ellipsoid.

Pods distinctly compressed and acute at the apex.

Pods 6–8 mm. long; plant usually over 1 dm. high.

Basal leaf-blades broadly oval; septum elliptic in outline; style equalling the pod in length.

1. *L. Shearis*.

Basal leaf-blades oblanceolate to obovate; septum ovate in outline; style much shorter than the pod.

2. *L. curvipes*.

Pods 3–5 mm. long; plant 1 dm. or less high.

Leaves narrowly linear-oblanceolate; plant pulvinate.

3. *L. alpina*.

Leaves narrowly linear; plant multicapital with a subterranean woody caudex.

4. *L. parvula*.

Pods not compressed above.

Basal leaf-blades rounded or broadly spatulate.

Stem-leaves small, generally less than 1 cm. long, linear-oblanceolate.

5. *L. prostrata*.

Stem-leaves oblanceolate to obovate, 1–2 cm. long.

6. *L. montana*.

Basal leaf-blades linear-oblanceolate.

7. *L. arenosa*.

Pods globose.

Stem very slender; stem-leaves oblanceolate, 1–3 cm. long.

7. *L. arenosa*.

Stem stouter, strict; stem-leaves linear, 2–6 cm. long.

8. *L. argentea*.

Ovary and pod glabrous, globose.

Basal leaf-blades oblanceolate.

Plant usually over 3 dm. high; flowers and fruit corymbose.

Plant usually less than 3 dm. high; inflorescence at least in fruit elongated,
racemose.

Basal leaves broadly oval.

9. *L. Engelmanni*.

10. *L. stenophylla*.

11. *L. ovalifolia*.

1. *Lesquerella Shearis* Rydb. On plains and foot-hills of Colo.—Alt. 5000–8000 ft.—Boulder; Palmer Lake; Idaho Springs.

2. *Lesquerella curvipes* A. Nels. On dry hills from Mont. to Colo.—Alt. up to 10,000 ft.—Como.

3. *Lesquerella alpina* (Nutt.) S. Wats. (*Vesicaria alpina* Nutt.) Dry Hills from N. D. and Mont. to Colo.—Florence; North Park.

4. *Lesquerella parvula* Greene. On dry hills in Colo.—Mt. Bross, Middle Park.

5. *Lesquerella prostrata* A. Nels. In dry places, in the mountains, from Ass. to Colo.—Alt. 5000–8000 ft.—Northern State line; mountain near Veta Pass; between La Veta and Gardner.

6. *Lesquerella montana* (A. Gray) S. Wats. (*Vesicaria montana* A. Gray) On hillsides and in the mountains from Wyo. to N. M.—Alt. 5000–11,000 ft.—Larimer Co.; Horsetooth Gulch; Palmer Lake; Fossil Creek; Ft. Collins; Rist Cañon, Larimer Co.; Salida; Mancos; Trinidad; mesas near Colorado Springs; river bluffs north of La Veta; Los Pinos; plains near Denver; hills southeast of La Veta; Manitou; Veta Pass; South Park.

7. *Lesquerella arenosa* (Richardson) Rydb. On dry hills from Sask. to S. D. and Colo.—Dolores.

8. *Lesquerella argentea* (Pursh) MacM. (*Vesicaria Ludoviciana* DC.) On plains and dry hills from Minn. to N. D., Kans. and Colo.—Wray; north of Craig, Routt Co.; Clear Creek; 25 miles below Manitou.

9. *Lesquerella Engelmanni* (A. Gray) S. Wats. On dry mesas from Kans. and Colo. to Tex. and N. M.—Pueblo.

10. *Lesquerella stenophylla* (A. Gray) Rydb. (*Vesicaria stenophylla* A. Gray and *V. Fendleri*, in part.) On dry mesas from Colo. to Tex. and N. M.; also in Mex.—Alt. 4000–5000 ft.—Florence; Swallow's, between Pueblo and Cañon City; mesas near Pueblo; Brantly Cañon, Las Animas Co.; Pueblo.

11. *Lesquerella ovalifolia* Rydb. (*L. ovata* Greene.) On dry mesas and hillsides from Neb. to Colo. and Kans.—Alt. about 1500 m.—Mesas near Pueblo.

10. RORIPA Scop. WATER-CRESS.

Aquatics, usually immersed and rooting, with pinnate leaves and white petals.

1. *R. Nasturtium*.

Terrestrial or marsh plants with pinnatifid leaves and yellow petals (except in *R. trachycarpa*).

Perennials with rootstocks; petals much exceeding the sepals.

Pods papillose.

Leaves thin; petals white; fruit recurved.

2. *R. trachycarpa*.

Leaves thick; petals yellow; fruit erect.

3. *R. calycina*.

Pods not papillose.

4. *R. sinuata*.

Annuals or biennials.

Pods spherical to oblong-ellipsoid; in the latter case shorter than the pedicels.

Pedicels 4–10 mm. long; pods 3–5 mm. long (rarely 6–7 mm. in *R. palustris*),

1.5–2 mm. thick.

Stem more or less hirsute.

5. *R. hispida*.

Stem glabrous.

Stem tall, 3-8 dm. high; stigma prominent, 2-lobed.

6. *R. palustris*.

Stem low, divaricately branched, 1-3 dm. high; stigma scarcely thicker than the style.

7. *R. alpina*.

Pedicels 2-5 mm. long; pods globose.

8. *R. sphaerocarpa*.

Pods oblong to linear-cylindric, equalling or longer than the short pedicels.

Style about 1 mm. long.

Leaves nearly all pinnatifid with obtuse divisions.

9. *R. obtusa*.

Leaves mostly sinuate, or, if pinnatifid, with acute divisions.

Pods short, ellipsoid, straight on straight pedicels.

8. *R. sphaerocarpa*.

Pods elongated ovoid, curved on curved pedicels.

10. *R. curvipes*.

Style minute, 5 mm. or less long.

Low, slender, less than 2 dm. high; leaves not auricled at the base.

11. *R. lyrata*.

Stouter, over 2 dm. high; petioles of the stem-leaves auricled at the base.

12. *R. Underwoodii*.

1. *Roripa Nasturtium* (L.) Rusby. (*Nasturtium officinale* R. Br.) In slow brooks and streams from N. S. to Wash., Va. and Calif.—Alt. 1200-2800 m.—Along Poudre, Ft. Collins; Durango; plains and foot-hills near Boulder; about Ouray; swamp near Ft. Collins.

2. *Roripa trachycarpa* (A. Gray) Greene. (*Nasturtium trachycarpum* A. Gray) On river banks in Colo.—Alt. about 6000 ft.—Walsenburg; "South-western Colorado."

3. *Roripa calycina* (Engelm.) Rydb. (*N. calycinum* Engelm.) On sandy river bottoms from Mont. to Wash. and N. M.—Alt. about 5000 ft.—Ft. Collins.

4. *Roripa sinuata* (Nutt.) A. S. Hitchc. (*Nasturtium sinuatum* Nutt.) On river banks and in wet ground from Minn. to Wash., Mo. and Ariz.—Alt. 4000-8000 ft.—Ft. Collins; Horsetooth Gulch; Gunnison; New Windsor; mesas near Pueblo; Pike's Peak; near Boulder.

5. *Roripa hispida* (Desv.) Britton. (*N. hispidum* Desv.) In swamps from N. B. to the Mackenzie and B. C., south to Fla. and N. M.—Alt. 4000-9000 ft.—Ft. Collins; Cache la Poudre banks; Quimby; plains and foot-hills near Boulder; Gunnison; Pass Creek.

6. *Roripa palustris* (L.) Bess. (*N. palustre* DC.) In swamps from Lab. to B. C., Ga., N. M. and Nev.—Alt. up to 10,000 ft.—Trapper's Lake; Durango; Twin Lakes.

7. *Roripa alpina* (S. Wats.) Rydb. (*N. obtusum alpinum* S. Wats.) In wet places in the mountains from Mont. and Ida. to Colo. and Utah.—Ft. Collins; Poudre Cañon; Steamboat Springs; Fish Creek; Hotchkiss.

8. *Roripa sphaerocarpa* (A. Gray) Britton. (*N. sphaerocarpum* A. Gray; *N. obtusum sphaerocarpum* S. Wats.) In wet places from Ills. to Wyo., Calif. and Ariz.—North Park, near Wyoming line; near Ironton, San Juan Co.

9. *Roripa obtusa* (Nutt.) Britton. On sandy beaches and river banks from Mich. to Wash., Tex. and Utah.—Alt. 4000-10,000 ft.—New Windsor; Mt. Harvard; Massif de l'Arapahoe; Hotchkiss, Delta Co.

10. *Roripa curvipes* Greene. In wet places in mountain valleys of Colo. and Wyo.—Alt. 7000-8000 ft.—Squaw Hill, above Cimarron; Dale Creek, Larimer Co.; Gunnison.

11 *Roripa lyrata* (Nutt.) Greene. (*N. lyratum* Nutt.) In sandy wet soil from Mont. to Wash., Colo. and Calif.—New Windsor.

12. *Roripa Underwoodii* Rydb. In wet places in the mountains of Colo.—Alt. about 11,000 ft.—Red Mountain, south of Ouray.

11. TURRITIS L.

1. *Turritis glabra* L. (*Arabis perfoliata* Lam.) In waste places and on sandy soil from Que. and Alb. to Pa., Colo. and Calif.—Alt. 4000-9000 ft.—Middle Park; Mancos; near Pagosa Peak; Almelia; Hotchkiss; Platte Cañon; Steamboat Springs.

12. SCHOENOCRAMBE Greene.

Leaves all linear, entire.

Plant decumbent, slender; pods ascending, more or less arcuate; style about 1 mm. long. 1. *S. decumbens*.

Plant erect, stouter; pods erect or nearly so, straight; style obsolete, 0.5 mm. or less long. 2. *S. linifolia*.

Some of the lower leaves pinnatifid. 3. *S. pinnata*.

1. *Schoenocrambe decumbens* Rydb. In dry places from Mont. to Colo. and Utah.—Alt. up to 7000 ft.—Gypsum.

2. *Schoenocrambe linifolia* (Nutt.) Greene. (*Sisymbrium linifolium* Nutt.) In dry places from Mont. to B. C., Colo. and Utah.—Alt. 5000-7000 ft.—Cimarron; Arboles; Grand Junction.

3. *Schoenocrambe pinnata* Greene. On dry hills from Wyo. to Colo. and Nev.—Alt. about 7000 ft.—Cimarron.

13. SISYMBRIUM L. HEDGE MUSTARD.

1. *Sisymbrium officinale* (L.) Scop. In waste places from Newf. to B. C., Fla. and Calif.; naturalized from Europe.—Platte near Denver (*Eastwood*).

14. SOPHIA Adans. HERB-SOPHIA, TANSEY-MUSTARD.

Pedicels ascending or spreading.

Pods linear, 1 mm. wide, somewhat curved; seeds in one row.

Pods 8-15 mm. long; stem simple or with ascending branches.

Pods divergent; segments of the uppermost leaves often entire.

1. *S. leptophylla*.

Pods ascending; segments of the leaves all sharply cut-lobed.

2. *S. incisa*.

Pods 5-8 mm. long; stem diffusely branched.

3. *S. purpurascens*.

Pods more or less clavate, 5-12 mm. long, 1-2 mm. wide; seeds usually in two more or less distinct rows.

Pods 8-12 mm. long, mostly erect on spreading pedicels.

Leaves and stem green, only sparingly stellate.

Stem divaricately branched; branches making with the stem an angle of 45° or more; pedicels 8-10 mm. long, usually shorter than the pods.

4. *S. ramosa*.

Stem simple or with erect or strongly ascending branches.

Petals much exceeding the sepals; terminal segments of the upper leaves usually elongated, linear, entire.

5. *S. filipes*.

Petals not much exceeding the sepals; terminal segment of the upper leaves not elongated.

6. *S. intermedia*.

Leaves and stem cinereous-stellate.

Petals longer than the sepals, about 2 mm. long; upper leaves mostly once pinnate, with elongated broad terminal segments.

7. *S. andrenarum*.

Petals not longer than the sepals, about 1.5 mm. long; upper leaves usually more dissected; terminal segment narrow, not elongated.

8. *S. halictorum*.

Pods 5-8 mm. long.

Pods acute above, acuminate below; style obsolete.

9. *S. pinnata*.

Pods acuminate at both ends; style evident.

10. *S. procera*.

Pedicels erect.

Pods over 1 mm. thick.

Plant green and almost glabrous.

10. *S. procera*.

Plant cinereous-pubescent.

11. *S. brevipes*.

Pods about .75 mm. thick; plant glandular puberulent, especially the inflorescence, or glabrous.

12. *S. glandulifera*.

1. *Sophia leptophylla* Rydb. In dry places from Wyo. and Ida. to Colo.—Alt. about 6500 ft.—Foot-hills, Larimer Co.; Bosworth's ranch; Stove Prairie.

2. *Sophia incisa* (Engelm.) Greene. On hillsides from Wyo. to N. M.—Alt. 6000-9000 ft.—Walcott; Chicken Creek; Idaho Springs; southeast of La Veta; Mancos; west of Steamboat Springs; Horsetooth Gulch; Cimarron; Glenwood Springs, Garfield Co.

3. *Sophia purpurascens* Rydb. On mountain sides in Colo.—Alt. about 11,000 ft.—Known only from the type locality: Red Mountain, south of Ouray.

4. *Sophia ramosa* Rydb. On mountain sides in Colo.—Alt. about 9000 ft.—Known only from Pitkin.

5. *Sophia filipes* (A. Gray) Heller. On hillsides from N. D. and Wash. to Colo.—Mancos.

6. *Sophia intermedia* Rydb. On hillsides and prairies and in sandy soil from Mich. and B. C. to Tenn. and Calif.—Alt. 4000-9000 ft.—Sangre de Cristo Creek; near Ironton, San Juan Co.; Buena Vista; Parlin; Mancos; plains near Denver; southeast and north of La Veta.

7. *Sophia andrenarum* Cockerell. On hillsides and in sandy valleys from Mont. and Wash. to N. M.—Alt. 4000-7000 ft.—Cañon City; Walsenburg; river bluffs north of La Veta; Cucharas Valley, near La Veta; Ft. Collins; New Windsor, Weld Co.; Los Pinos; near Poudre River; Antonito.

8. *Sophia halictorum* Cockerell. In sandy valleys from Colo. and Utah to Tex. and N. M.—Alt. up to 6000 ft.—Walsenburg.

9. *Sophia pinnata* (Walt.) Howell. In sandy soil from Va. and Colo. to Fla. and Ariz.—Alt. 4000-5500 ft.—Plains near Denver; mesas near Pueblo; Ft. Collins; Cache la Poudre; Lamar; Gypsum; New Windsor, Weld Co.

10. *Sophia procera* Greene. In sandy valleys from Wyo. to N. M. and Utah.—Alt. 7500-9000 ft.—Ironton Park, 9 miles south of Ouray; Box Cañon, west of Ouray; near Pagosa Peak; Tennessee Pass.

11. *Sophia brevipes* (Nutt.) Rydb. (*Sisymbrium canescens brevipes* Nutt.; *S. incisum Hartwegianum* S. Wats.; (?) *S. Hartwegianum* Fourn.) In sandy valleys, among bushes, from Mackenzie to Minn. and Utah.—Mancos; east side Poudre River, above Ft. Collins; Middle Park.

12. *Sophia glandulifera* Rydb. In sandy places from Wyo. to N. M.—La Veta.

15. **STENOPHRAGMA** Celac.

1. *Stenophragma virgata* (Nutt.) Greene. (*Sisymbrium virgatum* Nutt.)
In dry places in Wyo. and Colo.—Exact locality not given (*Hall & Harbour*);
McCoy's, Eagle Co.

16. **ERYSIMUM** L.

Petals less than 1 cm. long.

Petals 3–5 mm. long.

Petals 8–10 mm. long.

Petals over 1 cm. long.

Petals light yellow.

Plants biennial or short-lived perennials; not caespitose.

Basal leaves, as well as the whole plant, grayish.

Pods widely spreading, 5–8 cm. long, stout; stem-leaves usually sinuate-dentate.

Pods strongly ascending or almost erect, 8–12 cm. long.

Claws of the petals one-half longer than the sepals; stem-leaves broadly oblanceolate, usually sinuate-dentate.

Claws of the petals scarcely exceeding the sepals; stem-leaves entire or nearly so.

Stem-leaves linear or nearly so; pods usually twisted.

Stem-leaves oblanceolate; pods straight.

Basal leaves, at least, silvery white; stem leaves narrowly linear.

Plants 2–3 dm. high; stem-leaves sinuate-dentate.

Plants 1–2 dm. high; stem-leaves entire.

Plants low caespitose perennials.

Leaves entire-margined or nearly so.

Leaves sinuate-dentate.

Petals varying from orange to dark brown or purple.

Plant simple, 3–5 dm. high; basal leaves 5–10 cm. long, oblanceolate.

Plant caespitose, 1–2 dm. high; basal leaves 2–4 cm. long, spatulate.

1. *E. cheiranthoides*.

2. *E. parviflorum*.

3. *E. asperum*.

4. *E. elatum*.

5. *E. asperrimum*.

6. *E. oblanceolatum*.

7. *E. Bakeri*.

8. *E. argillosum*.

9. *E. nivale*.

10. *E. radiculatum*.

11. *E. Wheeleri*.

12. *E. amoenum*.

1. *Erysimum cheiranthoides* L. In waste places, on river banks and among bushes, from Newf. and Alaska to Tenn. and Utah.—Alt. 4000–9000 ft.—Headwaters of Sangre de Cristo Creek; Middle Park; along the Poudre; Ft. Collins; Grizzly Creek; North Park; New Windsor, Weld Co.

2. *Erysimum parviflorum* Nutt. (*E. inconspicuum* (S. Wats.) MacM.) On hillsides from Minn. and Alb. to Colo. and Nev.—Alt. 5000–8000 ft.—Dix Post Office; Mancos; Durango; Ruxton.

3. *Erysimum asperum* DC. Dry plains and hills, Sask. to Ark. and Colo.—Alt. 4000–9500 ft.—Butte, 5 miles southwest of La Veta; mountains between Sunshine and Ward.

4. *Erysimum elatum* Nutt. On hills from N. D., Mont. and Wash. to Colo. and Calif.—Alt. up to 6000 ft.—Foot-hills, Larimer Co.; Rist Cañon; Horsetooth Gulch; Quimby; Cucharas River, below La Veta; Horsetooth Gulch; Pike's Peak; Crystal Park; Camp Creek, Larimer Co.

5. *Erysimum asperrimum* (Greene) Rydb. (*Cheiranthus asperrimus* Greene) On hills from S. D. and Mont. to N. M. and Ariz.—Alt. 5000–9000 ft.—Sangre de Cristo Creek; Minnehaha; near Pueblo; Manitou; Williams' Cañon, above Manitou; Spring Cañon; Table Rock; Trinidad; Dixon Cañon; Howe's Gulch; Horsetooth Gulch; Rist Cañon.

6. *Erysimum ob lanceolatum* Rydb. In the mountains of Wyo. and Colo.—Alt. 5000–11,000 ft.—Golden; near La Plata Post Office; Hamor's Lake, above Durango; Williams' Cañon; near Pueblo; Georgetown; Stove Prairie Hill; Cameron Pass; Dixon Cañon; plains and foot-hills near Boulder; Alpine Tunnel; Cimarron.

7. *Erysimum Bakeri* (Greene) Rydb. (*Chieranthus aridus* Greene; *C. Bakeri* Greene) On dry hills in Colo. and N. M.—Golden City.

8. *Erysimum argillosum* (Greene) Rydb. (*C. argillosus* Greene) On dry mesas and bluffs of Colo.—Alt. about 5000 ft.—Pueblo; plains near Denver; bluffs north of La Porte.

9. *Erysimum nivale* (Greene) Rydb. (*C. nivalis* Greene) In the higher mountains of Wyo. and Colo.—Alt. 11,000–13,000 ft.—Mountains northeast of Boreas; mountains above Graymont; mountain northwest of Como; above Ouray; Carson; Argentine Pass; Mt. Hesperus, above timber line; Slide Rock Cañon; West La Plata Mountains.

10. *Erysimum radicum* Rydb. On the higher peaks of Colo.—Alt. 10,000–13,000 ft.—Pike's Peak; Bottomless Pit.

11. *Erysimum Wheeleri* S. Wats. (*E. asperum alpestre* Cockerell) On dry hills and plains in the mountains from Colo. and Utah to Tex. and Ariz.—Alt. 5000–12,000 ft.—Mountains between Sunshine and Ward; plains and foot-hills near Boulder; East Indian Creek; Turkey Creek and tributaries; Veta Mountain; Ojo; west slope Bald Mountain; Slide Rock Cañon, West La Plata Mountains; foot-hills near Ft. Collins; mountains near Veta Pass; headwaters of Pass Creek; Horsetooth Gulch; Howe's Gulch; Montrose; Dillon Cañon; Chicago Lakes; near Boulder.

12. *Erysimum amoenum* (Greene) Rydb. (*Cheiranthus nivalis amoenum* Greene.) On the higher peaks of Colo.—Alt. 10,000–13,000 ft.—La Plata Mountains; Silverton; near Ironton, San Juan Co.; Mt. Abram; mountains near Ouray; Berthoud Pass.

17. *BARBAREA* L. WINTER-CRESS, SCURVY-GRASS.

Pods sharply 4-angled, stout-pedicled; leaf-segments 4–8 pairs. 1. *B. praecox*.

Pods obtusely 4-angled; leaf-segments 1–4 pairs. 2. *B. americana*.

1. *Barbarea praecox* (J. E. Smith) R. Br. In waste places from N. Y. to Wash., Fla. and Calif.; sparingly introduced from Europe.—Hotchkiss.

2. *Barbarea americana* Rydb. (*B. vulgaris gracilis* S. Wats.; not DC.) In rich soil from Sask. and Mont. to Colo. and Nev.—Between Eldora and Baltimore.

18. *SINAPIS* L. WHITE MUSTARD.

1. *Sinapis alba* L. Introduced in grain fields and waste places from Me. to B. C. and Calif.—Ft. Collins.

19. *BRASSICA* L. WILD MUSTARD, TURNIPS, CABBAGE.

Pedicels 1–2 cm. long; plant glabrous.

1. *B. juncea*.

Pedicels about 5 mm. long; plant sparingly hispid.

2. *B. arvensis*.

1. *Brassica juncea* (L.) Coss. Sparingly introduced from Europe; in waste places from N. H. to Colo., Va. and N. M.—Alt. about 8000 ft.—Hills about Box Cañon, west of Ouray.

2. *Brassica arvensis* (L.) B. S. P. (*B. Sinapistrum* Boiss.) Introduced from Europe and sometimes a troublesome weed in grain fields from Newf. to Alb. and Colo.—Ft. Collins.

20. ALYSSUM L.

1. *Alyssum alyssoides* (L.) Gouan. (*A. calycinum* L.) In fields and waste places and on hillsides from N. H. and Iowa to N. J. and Colo.; introduced from Europe.—Alt. about 5000 ft.—Boulder.

21. DRABA L. WHITFLOW-GRASS.

Winter annuals or No. 7 sometimes perennial; style obsolete.

Pods hairy.

Flowers white; leaves all crowded on the lower part of the stem; racemes short on long naked peduncles.

Inflorescence even in fruit corymbiform; petals minute or none.

1. *D. micrantha*.

Inflorescence in fruit elongated; petals conspicuous.

2. *D. coloradensis*.

Flowers yellow or in age sometimes whitish; stem more or less leafy throughout.

Basal leaves obovate, ovate or oblong; stem-leaves ample; pedicels longer than the pods.

3. *D. nemorosa*.

Basal leaves oblanceolate or oblong; stem-leaves smaller, oblong-lanceolate; pedicels shorter than the pods.

4. *D. montana*.

Pods glabrous.

Stem more or less leafy.

Basal leaves obovate; stem-leaves several, broad.

5. *D. lutea*.

Basal leaves oblanceolate; stem-leaves very few and small.

6. *D. nitida*.

Stem scapiform or with a single leaf; leaves in basal rosettes.

Basal leaves oblanceolate or narrowly spatulate, hirsute.

7. *D. crassifolia*.

Basal leaves narrowly linear-oblanceolate, glabrous, except the very sparingly ciliate margins.

8. *D. Parryi*.

Perennials; style usually evident.

Plant scapose or nearly so; leaves ciliate on the margins.

Petals white.

9. *D. fladnizensis*.

Petals yellow.

D. streptocarpa Grayana.

Stem leafy.

Petals white; leaves stellate; plant usually over 1 dm. high.

10. *D. cana*.

Petals yellow.

Plants glabrous, except the margins of the leaves, which are occasionally ciliate.

Leaves linear or narrowly linear-oblanceolate, thin.

Leaves much shorter than the flowering stems; pods lance-linear.

11. *D. chrysantha*.

Leaves almost equalling the flowering stems; pods ovate.

12. *D. graminea*.

Leaves spatulate or broadly oblanceolate, thick.

13. *D. crassa*.

Plants decidedly hairy, at least on the stem.

Pubescence long-hirsute, with simple or slightly branched hairs.

14. *D. streptocarpa*.

Pubescence dense, mostly of branched or stellate hairs.

Styles 1.5–2 mm. long; pods glabrous or slightly puberulent.

Pubescence rather sparse and minute; stem-leaves usually sharply toothed.

15. *D. spectabilis*.

Pubescence dense and grayish; stem-leaves entire-margined or minutely denticulate.

16. *D. Helleriana*.

Style 1 mm. long; pod decidedly pubescent.

Stem erect or nearly so.

Leaves thin; basal ones usually over 2 cm. long; cauline ovate to lanceolate.

Petals 5 mm. or more long; stem-leaves often dentate.

17. *D. luteola*.

Petals 3-4 mm. long; stem-leaves entire-margined.

18. *D. aureiformis*.

Leaves thick; basal ones 1-2 cm. long; cauline lanceolate or oblong.

19. *D. aurea*.

Flowering stem decumbent; leaves finely stellate; pods twisted.

20. *D. decumbens*.

1. *Draba micrantha* Nutt. (*D. caroliniana micrantha* A. Gray) In arid soil from Ill. to Wash., Tex. and N. M.—Alt. 4000-6000 ft.—Mancos; Denver; foot-hills west of Ft. Collins.

2. *Draba coloradensis* Rydb. (*D. cuneifolia* Coult., in part; not Nutt.) On plains and hillsides of Colo.—Alt. 4000-5500 ft.—Hills west of Soldier Cañon; Ft. Collins; Mancos; foot-hills west of Ft. Collins; plains near Denver; near Boulder; New Windsor.

3. *Draba nemorosa* L. In dry places, often among grass, from Mich. to Mont., B. C., Colo. and Ore.—Alt. 4000-10,000 ft.—Georgetown; mountain near Veta Pass; foot-hills west of Ft. Collins; headwaters of Sangre de Cristo Creek; Rist Cañon; Horsetooth Gulch; Poudre River; west of Soldier Cañon; Howe's Gulch; near Chambers' Lake; Parlin, Gunnison Co.; Middle Park; Georgetown.

4. *Draba montana* S. Wats. In the mountains of Colo.—Alt. up to 2700 m.—Ironton Park, 9 miles south of Ouray.

5. *Draba lutea* Gilib. (*D. nemorosa leiocarpa*, in part) On hillsides from Hudson Bay to Alaska, Mich., Colo. and Ore.—Idaho Springs; Georgetown; Rabbit-Ear Range, Routt Co.

6. *Draba nitida* Greene. (*D. stenoloba* Wats. & Brew.; not Ledeb.) On hillsides from Wyo. to Ore., Colo. and southern Calif.—Alt. 8000-11,000 ft.—Near Teller, North Park; Tennessee Pass; Cameron Pass; mountains east of Cameron Pass; Grayback mining camps; Flat Top Mountains; Marshall Pass; Sargent's; South Park; near Chambers' Lake.

7. *Draba crassifolia* Graham. On exposed mountain-tops from Greenl. to B. C., Colo. and Utah.—Alt. 10,000-14,000 ft.—Mountains northeast of Boreas; near Ironton, San Juan Co.; vicinity of Como; Leroux Creek, Delta Co.; Sierra Blanca; Massif de l'Arapahoe; summit of North Park Range, Larimer Co.

8. *Draba Parryi* Rydb. On alpine peaks of Colo. and Wyo.—Alt. 10,000-13,000 ft.—Foot of Gray's Peak; Cameron Pass; Cumberland Basin, La Plata Mountains; Red Mountain; Alpine Tunnel.

9. *Draba fladnizensis* Wulf. In arctic regions and on alpine peaks, on wet rocks, from Lab. and B. C. to Colo. and Utah.—Alt. about 13,000 ft.—Gray's Peak trail; Gray's Peak; West Spanish Peaks; Parlin.

10. *Draba cana* Rydb. (*D. incana confusa* of Coult. Man.; not Poir.) In the mountains, among rocks, from Lab. and Yukon to Colo.—Alt. 11,000-12,000 ft.—Massif de l'Arapahoe; northeast of Boreas; Red Mountain; Pike's Peak.

11. *Draba chrysantha* S. Wats. On alpine peaks of Colo. and N. M.—Alt. 12,000–13,000 ft.—Gray's Peak.

12. *Draba graminea* Greene. On alpine peaks of Colo.—Alt. about 12,500 ft.—Telluride; Carson.

13. *Draba crassa* Rydb. On alpine peaks of Wyo. and Colo.—Alt. 8000–12,500 ft.—Cumberland Mine, La Plata Mountains.

14. *Draba streptocarpa* A. Gray. On alpine peaks and rocky places in the higher mountains of Colo.—Alt. 6000–13,000 ft.—Pike's Peak; headwaters of Clear Creek; South Park; Gray's Peak; West Indian Creek; West Spanish Peak; near Colorado Springs; headwaters of Sangre de Cristo Creek; mountains near Veta Pass; North Cheyenne Cañon; Robinson; northwest of Como; east of Cameron Pass; Pennock's mountain ranch; Beaver Creek; Chambers' Lake; Crystal Park; Gentian Ridge; headwaters of Clear Creek and alpine ridges east of Middle Park; Gray's Peak; South Park; Empire; Eldora to Baltimore.

Draba streptocarpa Grayana Rydb. Alpine peaks of Colo.—Alt. 12,000–13,000 ft.—Mountains northwest of Como; Gray's Peak trail.

15. *Draba spectabilis* Greene. In the mountains of Wyo. and Colo.—Alt. 9000–12,000 ft.—Near Ironton, San Juan Co.; Cumberland Basin and Bob Creek, La Plata Mountains; Upper La Plata Cañon; Mt. Hesperus; mountains about Ouray; Red Mountain.

16. *Draba Helleriana* Greene. (*D. oxyloba* Greene.) In the mountains of Colo. and N. M.—Alt. 8000–10,000 ft.—Sargent's; Van Boxle's ranch, above Cimarron; Grayback Mining Camps; headwaters of Sangre de Cristo Creek; Ojo; Silverton.

17. *Draba luteola* Greene. In the mountains of Colo.—Alt. 9000–12,000 ft.—Cumberland Basin, La Plata Mountains; Idaho Springs; Upper Cañon of the La Plata; near Pagosa Peak; Eldora to Baltimore.

18. *Draba aureiformis* Rydb. (*D. Bakeri* Greene.) In the mountains of Colo. and the Black Hills of S. D.—Alt. 9000–11,000 ft.—Near Graymont; headwaters of Pass Creek; Carson; Palsgrove Cañon.

19. *Draba aurea* Wahl. Among rocks in the higher mountains and in sub-arctic regions from Greenl. to B. C. to Colo. and Ariz.; also in northern Europe.—Alt. 9000–13,000 ft.—Headwaters of Clear Creek; Massif de l'Arapahoe; Battlement Crag, Pike's Peak; Como; West Spanish Peak; near Ironton, San Juan Co.; between Bald Mountain and Seven Lakes; Dark Cañon; Cripple Creek road; vicinity of Como; Boreas; Silverton; Leroux Creek; Chambers' Lake; Graymont; Alpine Tunnel; Grand Lake; Mt. Abram, Ouray; Mt. Baldy; Mt. Garfield; Middle Park; Eldora to Baltimore.

20. *Draba decumbens* Rydb. Alpine peaks of Colo.—Alt. 12,000–13,000 ft.—Gray's Peak.

22. CARDAMINE L. BITTER-CRESS.

Leaves all entire; blades more or less cordate, dentate.

Plant glabrous or nearly so.

1. *C. cordifolia*.

Plant, at least the stem, densely pilose; leaves also hairy.

2. *C. infausta*.

Leaves, at least some of them, pinnate.

Petals about 5 mm. long; leaflets 1–7; the terminal much larger, cordate, ovate or reniform, sinuately toothed.

3. *C. vallicola*.

Petals 2–4 mm. long; leaflets 5–15, from linear to obovate.

Plant perfectly glabrous; beak of the pod less than 1 mm. long.

4. *C. pennsylvanica*.

Plant more or less hairy, at least on the lower part of the stem or the base of the petioles; beak of the pod over 1 mm. long.

5. *C. acuminata*.

1. *Cardamine cordifolia* A. Gray. In brooks and on shady banks from Wyo. to N. M. and Ariz.—Alt. 7500–11,000 ft.—Rico; Gore Pass; Graymont; Chambers' Lake; Villa Grove; mountains between Sunshine and Ward; Marshall Pass; cañons and adjoining meadows west of Ouray; Idaho Springs; Clear Creek; Ironton; Tennessee Pass; near Pagosa Peak; on Bob Creek, West La Plata Mountains; Como; Silver Plume; Gray's Peak; Ojo; Pass Creek; Caribou; Eldora to Baltimore; summit of North Park Range, Larimer Co.; Spicer.

2. *Cardamine infausta* Greene. (*C. cardiophylla* Rydb.) In brooks in Colo.—Alt. up to 10,000 ft.—Above Beaver Creek; Tennessee Pass.

3. *Cardamine vallicola* Greene. In shady wet woods and on river banks in Wyo. and Colo.—Alt. 5000–8000 ft.—Bank of Poudre River, Ft. Collins; Columbine; Dale Creek.

4. *Cardamine pennsylvanica* Muhl. On shaded banks from Newf. to Wash., Fla., Kans. and Ore.—Walton Creek; North Park.

5. *Cardamine acuminata* Nutt. On shaded banks from Mont. to Alaska, Colo. and Ore.—Alt. about 5000 ft.—Ft. Collins.

23. ARABIS L. ROCK-CRESS.

Pods erect or nearly so.

Leaves coarsely hirsute; the cauline ones cordate or auricled at the base.

1. *A. ovata*.

Leaves not coarsely hirsute.

Pubescence if any sparse and consisting of 2-forked hairs.

Plant perfectly glabrous.

2. *A. philonipha*.

Lower leaves more or less hairy.

Lower leaves narrowly oblanceolate; cauline narrow and acuminate; pods about 1.5 mm. wide.

3. *A. oxyphylla*.

Lower leaves spatulate; cauline not long-acuminate; pods about 2 mm. wide.

4. *A. commixa*.

Pubescence of the lower leaves distinctly stellate.

Stem over 3 dm. high; basal leaves 3–10 cm. long; petals purple.

5. *A. oblanceolata*.

Stem usually less than 3 dm. high; basal leaves 1–2 cm. long; petals white or pinkish.

6. *A. Crandallii*.

Pods spreading or reflexed.

Leaves more or less stellate.

Leaves finely stellate without coarser simple hairs.

Stem 3–5 dm. high, branched; basal leaves oblanceolate, 5–10 cm. long, denticulate.

7. *A. Selbyi*.

Stems 1–4 dm. high, simple; basal leaves 1–5 cm. long.

Plant green, minutely stellate or sometimes glabrate; basal leaves usually entire.

12. *A. lignifera*.

Plant densely stellate; basal leaves dentate.

Petals about 8 mm. long; sepals and upper leaves usually glabrous.

13. *A. rhodantha*.

Petals about 6 mm. long; sepals stellate; leaves usually all stellate.

8. *A. consanguinea*.

Leaves hispid on the margins as well as stellate.

9. *A. Fendleri*.

Leaves not stellate, perfectly glabrous or with ciliate margins.

Plants not densely caespitose; stem-leaves lanceolate-sagittate; basal leaves oblanceolate or spatulate. 10. *A. divaricarpa*.

Plants densely caespitose; stem-leaves oblong or lance-oblong, indistinctly auricled; basal leaves narrowly linear-oblanceolate. 11. *A. oxylobula*.

1. *Arabis ovata* (Pursh) Poir. (*A. hirsuta* Hook., in part; not L.) In waste places and sandy or rocky soil from N. B. and Alb. to Ga. and Calif.—Alt. 4000–10,000 ft.—Boulder Cañon; Mancos; Ojo; Cucharas River, below La Veta; Pagosa Springs; West Indian Creek; South Park; Chicken Creek, La Plata Mountains; North Cheyenne Cañon; Williams' Cañon; butte, 5 miles southwest of La Veta; foot-hills, Larimer Co.; Horsetooth Gulch; gulch south of Boulder; Spring Cañon; Moon's ranch; Dixon Cañon; gulch west of Soldier Cañon; Rustic; Cache la Poudre; South Park; Colorado Springs; Castle Cañon; Cimarron; Lake City; Eldora to Baltimore.

2. *Arabis phyllonipha* A. Nelson. On hillsides from Mont. and Wash. to Colo. and Utah.—Alt. up to 9500 ft.—Breckenridge; Villa Grove; mountains between Sunshine and Ward.

3. *Arabis oxyphylla* Greene. On hillsides and in cañons from Wyo. to Colo. and Utah.—Alt. 7000–11,500 ft.—Cucharas River, below La Veta; Chicken Creek, West La Plata Mountains; Hounold; Cripple Creek road; near Pagosa Peak; near Chambers' Lake; Carson; Cerro Summit; Van Bogle's ranch, above Cimarron; Dark Cañon; Alpine Tunnel; Empire; Camp Creek, and Beaver Creek, Larimer Co.

4. *Arabis connexa* Greene. In the mountains from Mont. to Colo. and Utah.—Alt. 9000–11,000 ft.—Lake City; near Pagosa Peak; headwaters of Sangre de Cristo Creek; Eldora to Baltimore.

5. *Arabis oblanceolata* Rydb. On mountains in Colo.—Alt. about 10,000 ft.—Valley Spur.

6. *Arabis Crandallii* Robinson. (*A. stenoloba* Greene) In the mountains of Colo.—Alt. about 7000 ft.—Cimarron.

7. *Arabis Selbyi* Rydb. (*A. recondita* Greene, in part) On mountains of Colo.—Alt. 7000–9500 ft.—West of Ouray; Glenwood Springs (the last specimen included by Dr. Greene in *A. recondita* Greene, but does not agree with the description).

8. *Arabis consanguinea* Greene. In the mountains of Colo.—Alt. 7000–9000 ft.—Los Pinos; headwaters of Pass Creek; Van Bogle's ranch, above Cimarron.

9. *Arabis Fendleri* (S. Wats.) Greene. (*A. Hoelboellii Fendleri* S. Wats.) In the mountains of Colo. and N. M.—Alt. 7000–10,000 ft.—Georgetown; Como; butte, 5 miles southwest of La Veta; Wahatoya Cañon; river bluffs north of La Veta; hills southeast of La Veta; Mancos.

10. *Arabis divaricarpa* A. Nels. On dry hills from Ass. to Colo. and Utah.—Alt. 8000–9500 ft.—Mountains between Sunshine and Ward.

11. *Arabis oxylobula* Greene. In the mountains of Colo.—Leadville; Trapper's Lake; Glenwood Springs.

12. *Arabis lignifera* A. Nels. In the mountains of Wyo. and Colo.—Alt. about 8000 ft.—Columbine.

13. *Arabis rhodantha* Greene. In the mountains of Colo. and Utah.—Alt. up to 8000 ft.—Mancos; Ojo.

24. *CONRINGIA* Heist.

1. *Conringia orientalis* (L.) Dum. Introduced from Europe; from Me. and Alb. to Del. and Colo.—Minnehaha.

25. *STREPTANTHUS* Nutt.

1. *Streptanthus wyomingensis* A. Nels. On dry hills of Wyo. and Colo.—Alt. about 7000 ft.—Palisades, Mesa Co.; Cimarron; Glenwood Springs, Garfield Co.

26. *EUKLISIA* (Nutt.) Rydb.

Stem leaves oblong or ovate, with cordate base.

Leaves thick; sepals with bristles near the apex.

Leaves thin; sepals without bristles.

Stem leaves linear.

1. *E. crassifolia*.

2. *E. cordata*.

3. *E. longirostris*.

1. *Euklisia crassifolia* (Greene) Rydb. (*Streptanthus crassifolius* Greene) On dry hills from Colo. to Utah, N. M. and Ariz.—Alt. about 7000 ft.—Grand Junction; Cimarron.

2. *Euklisia cordata* (Nutt.) Rydb. (*Streptanthus cordatus* Nutt.) On dry hills from Wyo. to Colo. and Utah.—McCoy's, Eagle Co.; Mesa Verde.

3. *Euklisia longirostris* (S. Wats.) Rydb. (*Arabis* and *Streptanthus longirostris* S. Wats.) In valleys from Wyo. to Utah, N. M. and Ariz.—Palisades.

27. *THELYPODIUM* Endl.

Plant glabrous or with simple hairs.

Upper leaf-blades auricled at the base.

Petals rose-color, purplish or white.

Pods 7-10 cm. long.

Pods 3-5 cm. long.

Stem-leaves lanceolate-sagittate; petals rose or purplish.

Stem-leaves ovate-sagittate; petals white or straw color.

Petals bright yellow.

Upper leaf-blades attenuate at the base.

Some of the leaves sinuately toothed or laciniate.

Pedicels slender, 6-15 mm. long; upper leaves entire or slightly toothed; pods divergent.

Pedicels short and stout, 2-5 mm. long; most of the leaves laciniate; pods reflexed.

Leaves all entire or the lower sometimes repand.

Inflorescence dense; stigma truncate; lower leaf-blades obovate or oblanceolate.

Inflorescence very short; stipes 1 mm. long; pod rather stout.

Inflorescence more elongated; stipes 2-3 mm. long; pod very slender.

Inflorescence very slender and lax; stigmas conical; leaves all linear.

Plant pubescent with branched hairs.

1. *T. elegans*.

2. *T. paniculatum*.

3. *T. Bakeri*.

4. *T. aureum*.

5. *T. Wrightii*.

6. *T. utahensis*.

7. *T. integrifolium*.

8. *T. gracilipes*.

9. *T. linearifolium*.

10. *T. micranthum*.

1. *Thelypodium elegans* M. E. Jones. On adobe plains in Utah and Colo.—Southwestern Colorado.

2. *Thelypodium paniculatum* A. Nels. (*T. sagittatum* Endl.; *T. torulosum* Heller) On dry hills from Mont. to Colo. and Utah.—Alt. 7000-9500 ft.—On Grizzly Creek; Pearl North Park; Canadian River.

3. *Thelypodium Bakeri* Greene. On dry hills in Colo.—Alt. about 7000 ft.—Cimarron.

4. *Thelypodium aureum* Eastw. On dry hills in Colo.—Alt. about 5000 ft.—Durango.

5. *Thelypodium Wrightii* A. Gray. In the mountains of Colo., Utah, N. M. and Ariz.—Durango; Glenwood Springs, Garfield Co.

6. *Thelypodium utahense* Rydb. In river valleys of Colo. and Utah.—Minturn, Eagle Co.

7. *Thelypodium integrifolium* (Nutt.) Endl. (*T. lilacinum* Green.) On plains and in river-valleys from Mont. to Wash., Neb. and Calif.—Alt. 4000-8000 ft.—Miller's ranch; Ft. Collins; Poudre Cañon; Villa Grove; meadows, Lake John, Middle Park; New Windsor, Weld Co.; Doyle's; Hayden, Routt Co.

8. *Thelypodium gracilipes* (Robinson) Rydb. In valleys of Colo.—Alt. about 7000 ft.—Durango.

9. *Thelypodium linearifolium* (A. Gray) S. Wats. In river valleys and on hillsides from Colo. to Tex. and Ariz.; also in Mex.—Alt. 8000-9000 ft.—Sangre de Cristo Creek.

10. *Thelypodium micranthum* S. Wats. Rocky hills from western Tex. and Colo. to Ariz. and Mex.—Alt. about 7000 ft.—Manitou.

28. STANLEYA Nutt.

Blades of the petals linear-oblong to elliptic; flowers bright yellow.

Blades of the petals one-third to one-half as long as the claws.

Pod decidedly tortuose.

Pod arcuate, not tortuose.

1. *S. bipinnata*.

2. *S. glauca*.

Blades of the petals about as long as the claws.

Leaf-blades broadly lanceolate, the lower with short, broad lobes; blades of the petals oblong; pod ascending.

3. *S. integrifolia*.

Leaf-blades linear-lanceolate, all often entire; blades of the petals broadly elliptic; pod recurved.

4. *S. arcuata*.

Blades of the petals rounded oval; flowers ochroleucous.

5. *S. albescens*.

1. *Stanleya bipinnata* Greene. In dry places of Wyo. and Colo.—North Fork, Larimer Co.

2. *Stanleya glauca* Rydb. In dry soil from N. D. to Wyo., Colo. and Utah.—Alt. 4000-8000 ft.—Entrance of Soldier Cañon to Sulphur Springs; north of Ft. Collins; Arkansas River; Cedar Hills; Ft. Collins; Florence; Dixon Cañon; Spring Cañon; near Badito, between La Veta and Gardner; Mancos; McElmo Cañon; Garden of the Gods; Pueblo; Pike's Peak.

3. *Stanleya integrifolia* James. (*S. pinnatifida integrifolia* Robinson) In dry soil from S. D. to Wyo., Kans. and Colo.—Alt. 4000-7000 ft.—Hochkiss, Delta Co.; Cimarron.

4. *Stanleya arcuata* Rydb. In dry soil from Wyo. to Nev., Colo. and Calif.—Grand Junction.

5. *Stanleya albescens* Jones. On river banks in western Colo. and N. M.—Along Gunnison River, above Delta; Grand Junction.

Family 6o. **CAPPARIDACEAE** Lindl. CAPER FAMILY.

Pods elongated; receptacle with an appendage or gland.

Appendage tubular; petals cuneate-flabelliform, lacinate, very unequal.

Appendage solid; petals entire, emarginate or 3-toothed, but not lacinate.

Stamens 12-24; capsule sessile or short stipitate.

Stamens 6; capsule long-stipitate.

Pods short, broader than long, more or less flattened contrary to the partition; receptacle without appendage.

1. **CRISTATELLA**2. **POLANISIA**.3. **PERITOMA**.4. **CLEOMELLA**.1. **CRISTATELLA** Nutt.

1. *Cristatella Jamesii* T. & G. In sandy soil from Neb. and Colo. to Tex.—Sterling, Logan Co.

2. **POLANISIA** Raf.

1. *Polanisia trachysperma* T. & G. In sandy soil from Ass. to Tex. and Nev.—Alt. 4000-7000 ft.—Cañon City; plains and foot-hills near Boulder; New Windsor, Weld Co.; Ft. Collins; Salida; Howe's Gulch; Mason's river-front farm; Rocky Ford; Soldier Cañon; Poudre Cañon.

3. **PERITOMA** DC.

Petals yellow.

Petals purple, pink or white.

Petals 8-12 mm. long, usually 3-toothed.

Stamens exserted; petals usually rose color or purplish.

Stamens included; petals white,

Petals about 4 mm. long, entire.

1. *P. luteum*.2. *P. serrulatum*.3. *P. inornatum*.4. *P. Sonorae*.

1. *Peritoma luteum* (Hook.) Greene. (*Cleome lutea* Nutt.) In sandy soil from Wyo. and Wash. to Colo., Ariz. and Ore.—Alt. 4000-8000 ft.—Grand Junction; Cimarron and Squaw Hill; Gunnison Valley, above Delta.

2. *Peritoma serrulatum* (Pursh) DC. (*Cleome serrulata* Pursh.) In valleys, especially in light or sandy soil, from Sask. and Ida. to Mo. and Ariz.—Alt. 4000-9000 ft.—Boulder; Colorado Springs; Gunnison; Sapinero; Durango; Manitou; along Uncompahgre River, near Ouray; Crow Creek; along Platte River, Denver; Ft. Collins; Poudre flats, north of Ft. Collins; Trinidad; near Badito, between La Veta and Gardner; Sangre de Cristo Creek; Redstone; Pueblo; Dixon Cañon; Ft. Collins; Cache la Poudre; Walsenburg; Manitou.

3. *Peritoma inornatum* Greene. In dry soil in western Colo.—Grand Junction.

4. *Peritoma Sonorae* (A. Gray) Rydb. (*Cleome Sonorae* A. Gray.) In saline soil from Colo. to N. M. and Sonora.—Alt. 4000-5000 ft.—Saguache; San Luis; Alamosa.

4. **CLEOMELLA** DC.

Capsule rhomboidal, with more or less distinct conical or horn-like projections; stipe shorter than the pedicels; style obsolete; seeds rugulose.

Capsule obscurely rhomboidal, merely gibbous on the back; stipe equalling the pedicels; style conspicuous; seeds smooth and shining.

1. *C. angustifolia*.2. *C. oocarpa*.

1. *Cleomella angustifolia* Torr. In valley, especially in sandy or alkaline soil, from Neb. and Utah to Tex.—Headwaters of Clear Creek; Julesburg.
 2. *Cleomella oocarpa* A. Gray. In alkaline plains and desert regions from Colo. to Calif.—Mesa Verde, about Rio Mancos (*Brandegee*).

Order 27. ROSALES.

Flowers regular or nearly so (actinomorphic).

Endosperm present usually copious and fleshy; stipules mostly wanting.

Herbs.

Carpels as many as the sepals; succulent plants.

Fam. 61. CRASSULACEAE.

Carpels fewer than the sepals; plant scarcely succulent.

Staminodia wanting; carpels 2 or rarely 3, distinct or only partly united.

Fam. 62. SAXIFRAGACEAE.

Staminodia present; carpels 3 or 4, wholly united into a 1-celled gynoeceum.

Fam. 63. PARNASSIACEAE.

Shrubs or trees.

Leaves opposite; fruit a leathery capsule, more or less adnate to the hypanthium; stipules wanting.

Fam. 64. HYDRANGIACEAE.

Leaves alternate.

Fruit thin-walled follicles, free from the hypanthium; stipules present (*Opulaster* in)

Fam. 66. ROSACEAE.

Fruit a berry; hypanthium adnate to and prolonged beyond the ovary.

Fam. 65. GROSSULARIACEAE.

Endosperm wanting or scant; stipules mostly present.

Carpels several or numerous, or, if solitary, becoming an achene.

Carpels distinct, free from the hypanthium; fruit achenes, follicles or drupelets.

Fam. 66. ROSACEAE.

Carpels united, enclosed by and adnate to the hypanthium; fruit a pome.

Fam. 67. MALACEAE.

Carpel solitary, not becoming an achene.

Ovary 2-ovuled; fruit a drupe; leaves simple.

Fam. 68. AMYGDALACEAE.

Ovary several-ovuled; fruit a legume; leaves pinnately compound.

Fam. 69. MIMOSACEAE.

Flowers irregular (mostly zygomorphic).

Upper petal enclosed by the lateral ones in the bud; corolla not papilionaceous.

Fam. 70. CASSIACEAE.

Upper petal enclosing the lateral ones in bud; corolla papilionaceous.

Fam. 71. FABACEAE.

Family 61. CRASSULACEAE DC. ORPINE FAMILY.

Stamens as many as the sepals; minute herbs.

1. TILLAEASTRUM.

Stamens twice as many as the sepals; succulent herbs.

Flowers axillary in dense congested racemes; petals rose-colored.

2. CLEMENTSIA.

Flowers terminal, arranged in one-sided raceme-like branches.

Carpels erect; flowers polygamous or dioecious; petals in ours purplish.

3. RHODIOLA.

Carpels spreading; flowers perfect; petals in ours yellow.

4. SEDUM.

1. TILLAEASTRUM Britton. PIGMY-WEED.

1. *Tillaeastrum aquaticum* (L.) Britt. (*Tillaea aquatica* L.; *T. angustifolia* Nutt.) On muddy shores from N. S. and Wash. to Md., La. and Lower Calif.—Alt. up to 10,000 ft.—Twin Lakes.

2. CLEMENTSIA Rose. RED ORPINE.

1. *Clementsia rhodantha* (A. Gray) Rose. (*Sedum rhodanthum* A. Gray) In meadows and along streams from Mont. to Colo. and Ariz.—Alt. 10,000–13,000 ft.—Gray's Peak; headwaters of Clear Creek; Caribou; Pike's Peak; Gore Pass; Cameron Pass; Pagosa Peak; Villa Grove; Dark Cañon; Marshall Pass; near Georgetown; Twin Lakes; Chambers' Lake; Berthoud Pass.

3. RHODIOLA L. ROSE-ROOT, ROSE-WORT.

Flowers dioecious; carpels 3–5 mm. long, abruptly contracted into a short divergent or reflexed beak. 1. *R. integrifolia*.
Flowers polygamous; carpels 6–8 mm. long, gradually tapering into a long ascending beak. 2. *R. polygama*.

1. *Rhodiola integrifolia* Raf. (*Sedum rhodiola* Coult., in part; not DC.; *Sedum frigidum* Rydb.) On high alpine peaks from Alb. and Alaska to Colo. and Calif.—Alt. 9000–14,000 ft.—Pike's Peak; Mount Garfield; Grayback mining camps; West Spanish Peak.

2. *Rhodiola polygama* (Rydb.) Britt. & Rose. (*Sedum polygamum* Rydb.) On alpine peaks of Colo. and N. M.—Alt. 9000–13,000 ft.—Engineer Mountain; headwaters of Clear Creek; Carson; Basin Creek, La Plata Mountains; Mount Hesperus; near Ironton; Pike's Peak; Chambers' Lake; Mt. Lincoln; West Spanish Peak; South Park; Leroux Park; Estes Park; Bethoud Pass.

4. SEDUM L. STONE-CROP, ORPINE.

1. *Sedum stenopetalum* Pursh. On dry rocky or gravelly hills from Alb. and B. C. to N. M. and Calif.—Alt. 4000–12,000 ft.—Gray's Peak; Pike's Peak; Clear Creek Cañon; Colorado Springs; headwaters of Clear Creek; Cameron Pass; Larimer Co.; Hamor's Lake; Bald Mountain; Mt. Garfield; Grayback mining camp; Silver Plume; Morrison; Telluride; Minnehaha; Cimarron; Denver; West Spanish Peak; Ft. Collins; Ironton; Green Mountain Falls; Howe's Gulch; mountains southeast of Cameron Pass; forks of Poudre and Big South; gulch west of Pennock's; Horsetooth Gulch; near Narrows; Dixon Cañon; Table Rock; mountains between Sunshine and Ward.

Family 62. SAXIFRAGACEAE Dumort. SAXIFRAGE FAMILY.

Placentae parietal, sometimes nearly basal.

Flowers solitary and axillary to leaf-like bracts, or 2–4 in small corymbs, each subtended by a leaf-like bract. 1. CHRYSOSPLENIUM.

Flowers in more or less elongated racemes or panicles.

Flower-stalk axial from a slender bulbiferous rootstock; gynoeceium 3-carpellary. 2. LITHOPHRAGMA.

Flower stalks a lateral shoot from a stout scaly rootstock; gynoeceium 2-carpellary.

Inflorescence racemose.

Petals pinnately cleft or pinnatifid. 3. PECTANTIA.

Petals entire, toothed or 3-cleft above. 4. OZOMELIS.

Inflorescence paniculate; petals broadened upward. 5. HEUCHERA.

Placentae axial.

- Hypanthium well developed and accrescent, at maturity longer than the sepals.
 Stamens 5; sepals imbricated; petals marcescent. 6. SULLIVANTIA.
 Stamens 10; petals not marcescent.
 Petals clawed; styles partially united; plants with thick rootstocks. 7. TELESONIX.
 Petals clawless; styles distinct; plants with slender rootstocks or with offsets.
 Plants without caudices, only producing annual flowering stems. 8. SAXIFRAGA.
 Plants with perennial, very leafy caudices, often with offsets; the flowering stems very different. 9. MUSCARIA.
 Hypanthium only slightly developed, unchanged at maturity, or if slightly accrescent flat and plants acaulescent.
 Plants acaulescent.
 Corolla essentially regular, the petals about equal in shape and length. 10. MICRANTHES.
 Corolla irregular, 3 petals with blades of an ovate or lanceolate type and 2 narrower and longer. 11. SPATULARIA.
 Plants caulescent. 12. LEPTASEA.

1. CHRYSOSPLENIUM L. GOLDEN SAXIFRAGE.

1. *Chrysosplenium tetrandrum* Fries. In wet places from Greenl. and Alaska to Alb. and B. C.; also in Colo. and northern Europe.—Upper Platte (Hall & Harbour).

2. LITHOPHRAGMA Nutt.

- Hypanthium campanulate, with a rounded base, adnate only to the base of the ovary.
 Stem-leaves rarely bulbiferous in the axils; stipules long and narrow; free portion triangular or lanceolate, not fimbriate. 1. *L. australis*.
 Stem-leaves usually bulbiferous in the axils; stipules short and broad; free portion round and fimbriate. 2. *L. bulbifera*.
 Hypanthium turbinate or obconic, adnate to the lower half of the ovary. 3. *L. parviflora*.

1. *Lithophragma australis* Rydb. In sandy mountain valleys and hillsides from Wyo. and Utah to N. M. and Ariz.—Alt. 7000-9000 ft.—Platte Cañon; headwaters of Sangre de Cristo Creek; Van Boxle's ranch, above Cimarron.

2. *Lithophragma bulbifera* Rydb. (*Tellima tenella* S. Wats.) On hillsides from the Black Hills of S. D., Mont. and B. C. to Colo. and Calif.—Alt. up to 11,000 ft.—Tennessee Pass.

3. *Lithophragma parviflora* (Hook.) Nutt. (*Tellima parviflora* Hook.) In rocky and gravelly places from Alb. to B. C., Colo. and Calif.—Locality not given.

3. PECTIANTHIA Raf. MITRE-WORT.

1. *Pectianthia pentandra* (Hook) Rydb. (*Mitella pentandra* Hook.) In springy places in the woods and along streams, from Alb. and Alaska to Colo. and Calif.—Alt. 8000-12,000 ft.—Beaver Creek; Marshall Pass; Red Mountain; Slide Rock Cañon; Empire; Estes Park; Berthoud Pass; Cameron Pass; Ruby; Damfino Creek; headwaters of Clear Creek and alpine ridges east of Middle Park; Empire; Caribou; Golden.

4. OZOMELIS Raf. MITRE-WORT.

Petals 3-fid to the middle; hypanthium with the sepals 3-5 mm. long.

1. *O. stauropetala*.

Petals entire or 3-fid only at the apex; hypanthium with the sepals 1.5-3 mm. long. Hypanthium with the sepals 2-3 mm. long; leaf-blades indistinctly lobed and with shallow crenulations; petals often entire.

2. *O. stenopetala*.

Hypanthium with the sepals 1.5-2 mm. long; leaf-blades distinctly lobed and deeply crenate; petals 3-cleft.

3. *O. Parryi*.

1. *Ozomelis stauropetala* (Piper) Rydb. (*Mitella stauropetala* Piper; *M. trifida* Coulter, in part.) In springy places in the woods from Mont. and Wash. to Colo. and Ore.—Alt. about 10,000 ft.—Mt. Hesperus.

2. *Ozomelis stenopetala* (Piper) Rydb. (*Mitella stenopetala* Piper) In springy places in Utah and Colo.—Alt. 8000-10,000 ft.—Mt. Hesperus; Eldora to Baltimore.

3. *Ozomelis Parryi* (Piper) Rydb. (*Mitella stenopetala Parryi* Piper) Mountains of Wyo. and Colo.—Alt. about 9500 ft.—Trapper's Lake.

5. HEUCHERA L. ALUM-ROOT.

Stamens equalling or exceeding the sepals.

Panicle open, not spike-like; plant tall; hypanthium very oblique.

1. *H. hispida*.

Panicle contracted, dense, spike-like; plant low; hypanthium not very oblique.

2. *H. bracteata*.

Stamens much shorter than the sepals.

Hypanthium campanulate, yellowish or pinkish; sepals almost erect.

3. *H. Hallii*.

Hypanthium saucer-shaped, greenish; sepals spreading.

4. *H. parvifolia*.

1. *Heuchera hispida* Pursh. In woods and on hillsides, Ont. to Ass., Va. and Colo.—Edgerton.

2. *Heuchera bracteata* (Torr.) Ser. On rocky ridges in Colo. and northern Wyo.—Alt. 6000-10,000 ft.—Rist Cañon; Grand Lake; Georgetown; Andrew's Shetland ranch; foot-hills, Larimer Co.; Gray's Peak; North Cheyenne Cañon; Boulder Cañon; road between Denver and Idaho City; Horsetooth Mountain; mountains between Sunshine and Ward; Eldora to Baltimore; Berthoud Pass; between Denver and Idaho City; Golden; Empire.

3. *Heuchera Hallii* A. Gray. On rocky ridges in Colo.—Alt. 7000-12,000 ft.—Mt. Garfield; Cameron's Cone; Pike's Peak; Rock Mountain Pass; Georgetown; Ruxton; Pike's Peak; Cheyenne Mountain; Bald Mountain; Grand Cañon of the Arkansas; Graymont.

4. *Heuchera parvifolia* Nutt. On hills from Alb. and Ore. to N. M. and Ariz.—Alt. 6000-13,000 ft.—Mt. Abram, Ouray; foot-hills, Larimer Co.; Cameron Pass; Howe's Gulch; Minnehaha; Marshall Pass; Colorado Springs; Douglass Mountain, Georgetown; Van Boxle's ranch, above Cimarron; Halfway House; Chicken Creek, West La Plata Mountains; Grizzly Creek; near La Veta; Ojo; Cumberland Basin; Upper La Plata Cañon; North Cheyenne Cañon; near Pagosa Peak; Ironton; Wahatoya Cañon; Veta Pass; Mt. Princeton; West Spanish Peak; Ward, Boulder Co.; Red Mountain; Manitou; Lake City; Caribou; Dillon Cañon, Trinidad; Estes Park; Empire; northeast of Boreas; Spring Cañon; Dixon Cañon; Horse-

tooth Gulch; Mancos; Ute Pass; Golden; Sangre de Cristo; Hahn's Peak; Fish Creek Falls, Routt Co.

6. SULLIVANTIA T. & G.

1. *Sullivantia Hapemanii* (Coult. & Fish.) Coulter. (*Boykinia Purpusi* Brandege.) In rocky places from Wis. and Wyo. to Colo.—Black Cañon of the Gunnison.

7. TELESONIX Raf.

1. *Telesonix Jamesii* (Torr.) Raf. (*Saxifraga Jamesii* Torr.) On exposed mountain-tops in Colo.—Alt. 8000–13,000 ft.—Mt. Garfield; Pike's Peak; Minnehaha.

8. SAXIFRAGA L. SAXIFRAGE.

Flowers normal, none of them represented by clusters of bulblets. 1. *S. debilis*.
Flowers below the terminal one replaced by clusters of bulblets.

Lobes of the stem-leaves linear to triangular lanceolate; petals cuneate.

2. *S. cernua*.

Lobes of the stem-leaves broad and rounded, as broad as long or broader; petals fiddle-shaped.

3. *S. simulata*.

1. *Saxifraga debilis* Engelm. Among wet rocks, on alpine peaks, from Mont. to Colo. and Utah.—Alt. 9000–13,000 ft.—Mt. Hesperus; Sierra Blanca; Mt. Abram, Ouray; Front Range, Larimer Co.; Redcliffe, Eagle Co.; West Spanish Peak; Gray's Peak; Cameron Pass; Bottomless Pit, near Pike's Peak; Ruby; Massif de l'Arapahoe; mountains above Beaver Creek.

2. *Saxifraga cernua* L. Among wet rocks, on alpine peaks, from Greenl. and Alaska to Lab. and Colo.; also in Europe.—Alt. about 13,000 ft.—Mt. Abram, Ouray.

3. *Saxifraga simulata* Small. Among rocks, on the higher peaks, in the Black Hills of S. D. and Colo.—Alt. 10,000–13,000 ft.—West Spanish Peak.

9. MUSCARIA Haw.

Leaves of the caudex with entire or slightly 3-toothed blades. 1. *M. adscendens*.

Leaves of the caudex with 3-cleft or prominently 3-lobed blades.

2. *M. delicatula*.

1. *Muscaria adscendens* (L.) Small. (*Saxifraga adscendens* L.) Among rocks, on alpine peaks, from Alb. and B. C. to Colo. and Utah.—Alt. 10,000–13,000 ft.—Gray's Peak; Deep Creek Lake; West Spanish Peak; Pike's Peak.

2. *Muscaria delicatula* Small. On alpine peaks from Alb. to Colo. and Utah.—Gray's Peak.

10. MICRANTHES Haw.

Filaments subulate or filiform-subulate, or rarely narrowly linear.

Cymules wholly or mainly aggregated into a head, or one or two lower ones remote or peduncled; leaves petioled; blades rhombic ovate.

1. *M. rhomboidea*.

Cymules in narrow pyramidal or corymb-like panicles; leaves subsessile, oblanceolate-oblong.

Panicle wide, peduncles of the lower cymules elongated.

2. *M. arnoglossa*.

Panicle narrow; peduncles permanently very short.

3. *M. brachypus*.

Filaments clavate or spatulate; petals spotted.

4. *M. arguta*.

1. *Micranthes rhomboidea* (Greene) Small. (*Saxifraga rhomboidea* Greene.) Among rocks in the mountains from Mont. and Ida. to Colo.—Alt. 5000–12,000 ft.—Gray's Peak; West Spanish Peak; near Ironton; Grand Mesa; Marshall Pass; Seven Lakes; Black Rock Creek; Pike's Peak; Ft. Collins; Georgetown; foot-hills, Larimer Co.; Tennessee Pass; Bear Creek Divide, West La Plata Mountains; Iron Mountain; headwaters of Beaver Creek; gulch west of Dixon Cañon; Massif de l'Arapahoe; near Pagosa Peak; Rist Cañon; mountains west of Cameron Pass; Soldier Cañon; Boreas; Beaver Creek; Eldora to Baltimore; Berthoud Pass; Rabbit-Ear Range, Routt Co.

2. *Micranthes arnoglossa* (Greene) Small. (*Saxifraga arnoglossa* Greene.) On hills and mountains from Mont. and Wash. to Colo. and Calif.—Alt. 9000–12,000 ft.—Mountains of Delta Co.; Marshall Pass; Silver Plume.

3. *Micranthes brachypus* Small. In the mountains from Colo. to Nev.—Alt. 11,000–12,000 ft.—Half-Moon Creek; Berthoud Pass.

4. *Micranthes arguta* (D. Don.) Small. (*Saxifraga arguta* D. Don.; *S. denudata* Nutt.; *S. punctata* Hook., in part; not L.) In springy places and along streams from Mont. and B. C. to N. M. and Calif.—Alt. 8000–12,000 ft.—Mountains between Sunshine and Ward; Villa Grove; Mt. Abram, Ouray; Dark Cañon; Wyoming line in North Park; Georgetown; Middle Park; Grayback mining camps; near Pagosa Peak; Pike's Peak; Rabbit-Ear Range; headwaters of Clear Creek; Silver Plume; Clear Lake; Berthoud Pass; Upper La Plata Cañon; Cameron Pass; Ruby; headwaters of Pass Creek; Massif de l'Arapahoe; Beaver Creek; Leroux Park, Graymont; Gore Pass; Anita Peak.

11. SPATULARIA Haw.

1. *Spatularia Vreelandii* Small. On the higher peaks of Mont. and Colo.—Mt. Evans.

12. LEPTASEA Haw.

Leaf-blades not spine-tipped at the apex, more or less ciliate.

Petals suborbicular or oval, 5.5–6.5 mm. long, abruptly narrowed into short claws.

Petals elliptic to oblong, 9–13 mm. long, clawless.

Leaf-blades spine-tipped at the apex.

Petals white, usually spotted, oblong or oblong-lanceolate or elliptic; plant caespitose, not stoloniferous.

Petals yellow, broadly obovate; plant with flagelliform stolons.

1. *L. chrysantha*.

2. *L. Hirculus*.

3. *L. austromontana*.

4. *L. flagellaris*.

1. *Leptasea chrysantha* (A. Gray) Small. (*Saxifraga chrysantha* A. Gray) On alpine peaks, among rocks, of Colo.—Alt. 11,000–14,000 ft.—Pike's Peak; Mt. Bartlett; Central City; Gray's Peak; mountains of Estes Park; Massif de l'Arapahoe; Berthoud Pass.

2. *Leptasea Hirculus* (L.) Small. (*Saxifraga Hirculus* L.) On the higher mountains, in wet places, from Greenl. and Alaska to Colo. and B. C.; also in Europe and Asia.—Alt. 9000–11,000 ft.—Beaver Park; Twin Lakes; Caribou.

3. *Leptasea austromontana* (Wieg.) Small. (*Saxifraga bronchiales* Torr.; not L.; *S. austromontana* Wieg.) On rocks and stony hills from Alb. and B. C. to N. M. and Wash.—Alt. 6000–13,000 ft.—Red Mountain; Ouray; Minnehaha; Mt. Garfield; Halfway House, Pike's Peak; Central City; West Spanish Peak; Little Veta Mountain; Black Cañon; Upper La Plata Cañon; Como; Silver Plume; near Colorado Springs; Pagosa Peak; El Paso Co.; Georgetown; near Denver; Andrew's Shetland ranch; Caribou; South Boulder Peak; Massif de l'Arapahoe; Palmer Lake; headwaters of Clear Creek; Lake City; near Empire; west of Cameron Pass; Graymont; Ragged Mountain, Gunnison Co.; Estes Park; Cameron Pass; mountains above Ouray; Buffalo Pass; Pennock's mountain ranch; Devil's Causeway; Twin Lakes; mountains between Sunshine and Ward; Anita Peak.

4. *Leptasea flagellaris* (Willd.) Small. (*Saxifraga flagellaris* Willd.) On alpine peaks, among rocks, from Greenl. and Alaska to Colo. and Ariz.—Alt. 10,000–14,000 ft.—Red Mountain; summit of Pike's Peak; Mt. Abram, Ouray; Cumberland Basin, La Plata Mountains; Mt. Harvard; Pike's Peak; West Spanish Peak; Gray's Peak; headwaters of Clear Creek; Massif de l'Arapahoe.

FAMILY 63. PARNASSIACEAE Dumort. GRASS-OF-PARNASSUS

FAMILY.

1. PARNASSIA L. GRASS OF PARNASSUS.

Petals fimbriate on the sides; basal leaf-blades reniform.

Petals obovate, 5-nerved; staminodial scales with 5–9 lobes; sepals elliptic.

1. *P. fimbriata*.

Petals oblong, 3-nerved; staminodial scales 3–5-lobed; sepals narrowly lanceolate.

2. *P. rivularis*.

Petals not fimbriate; basal leaf-blades tapering at the base.

3. *P. parviflora*.

1. *Parnassia fimbriata* Banks. On banks of streams and in springy places from Alb. and Alaska to Colo. and Calif.—Alt. 9000–11,000 ft.—Twin Lakes; North Park; Ruby; Ragged Mountain, Gunnison Co.; near Pagosa Peak; Cameron Pass; Marshall Pass; Caribou.

2. *Parnassia rivularis* Osterhout. Along mountain brooks in Colo.—North Park, near Wyoming line.

3. *Parnassia parviflora* DC. In wet places from Que. and Alaska to Colo. and Utah.—Alt. 7000–8000 ft.—North Park; Gypsum Creek; cañon, Eagle Co.; Pagosa Springs; Wahatoya Creek; Marshall Pass; Iola; Parlin; La Veta; Lake John, North Park; Buena Vista; Big Muddy, Gunnison Co.

Family 64. HYDRANGEACEAE Dumort. HYDRANGAEA FAMILY.

Stamens 15 or more; ovary inferior.

1. PHILADELPHUS.

Stamens 8–10; ovary mostly superior.

Hypanthium adnate to the base of the 1-celled ovary or incompletely 3–7-celled capsule; petals 5.

2. EDWINIA.

Hypanthium adnate for half its length to the 4-celled ovary and capsule; petals 4.

3. FENDLERA.

1. **PHILADELPHUS** L. SYRINGA, MOCK ORANGE.

Hypanthium 4-5 mm. long; sepals acuminate; leaves much paler beneath; styles united.

1. *P. microphyllus*.

Hypanthium about 2 mm. long or in fruit 3-4 mm. long; sepals acute.

Styles wholly or nearly wholly united; stigmas usually oblong.

2. *P. occidentalis*.

Styles with the upper half distinct; stigmas decidedly clavate.

3. *P. minutus*.

1. *Philadelphus microphyllus* A. Gray. Mountains of N. M. and Colo.—Brantly Cañon; Cañon City (*Brandegge*), "Colorado."

2. *Philadelphus occidentalis* A. Nels. Mountains from Wyo. to Colo. and Utah.—Alt. 5000-7000 ft.—Cañon City; Glenwood Springs (*A. Nelson*).

3. *Philadelphus minutus* Rydb. Cañons of Colo.—Alt. 7000 ft.—Black Cañon of the Gunnison.

2. **EDWINIA** Heller.

1. *Edwinia americana* (T. & G.) Heller. (*Jamesia americana* T. & G.)

On cliffs, mountain sides and in cañons, from Wyo. and Utah to N. M.—Alt. 5000-10,000 ft.—Rist Cañon; Minnehaha; Pike's Peak; Rock Mountain Pass; Ward; West Spanish Peak; Central City; Engelmann's Cañon; North Cheyenne Cañon; Green Mountain Falls; foot-hills, Larimer Co.; Georgetown; Cañon City; headwaters of Clear Creek and alpine ridges east of Middle Park; Manitou; Graymont; Narrows, Moon's ranch; Horsetooth Gulch; Soldier Cañon; Howe's Gulch; Pennock's mountain ranch; mountains between Sunshine and Ward; Eldora to Baltimore.

3. **FENDLERIA** Engelm. & Gray.

1. *Fendleria rupicola* Engelm. & Gray. On hills from Colo. to N. M. and Ariz.; also in Mex.—Alt. 5000-8000 ft.—Durango; Mancos; Cerro Summit; Los Pinos; Hotchkiss, Delta Co.; Dolores.

Family 65. **GROSSULARIACEAE.** GOOSEBERRY FAMILY.1. **RIBES** L. GOOSE-BERRY, CURRANT.

Leaves plicate in veneration.

Stems usually with subaxillary spines.

Racemes 1-4-flowered; hypanthium campanulate to tubular.

Calyx and tube of hypanthium externally glabrous or the former with a few scattered hairs.

Peduncles and bracts more or less glandular or pubescent; leaves finely puberulent.

1. *R. Purpusi*.

Peduncles and bracts glabrous or the latter ciliate; leaf-blades cordate at the base, in age glabrous and shining.

2. *R. vallicola*.

Calyx and hypanthium pubescent.

3. *R. leptanthum*.

Racemes several-flowered; hypanthium saucer-shaped.

Leaves densely pubescent; fruit red.

4. *R. lentum*.

Leaves glabrate; fruit black.

5. *R. parvulum*.

Stem unarmed; raceme many-flowered.

Hypanthium campanulate.

Berry glandular-bristly.

Leaves glabrous; fruit spherical.

Tube of the hypanthium saucer-shaped; bracts minute, lanceolate to linear; fruit without a bloom. 6. *R. coloradense*.

Tube of the hypanthium campanulate; fruit black with a bloom; bracts conspicuous oblong, spatulate or obovate. 7. *R. Wolfei*.

Leaves pubescent and often very glandular; fruit ovoid; tube of hypanthium deeply campanulate. 8. *R. viscosissimum*.

Berry glabrous; tube of the hypanthium deeply campanulate; fruit black; bracts persistent. 9. *R. floridum*.

Hypanthium tubular.

Petioles and veins of the leaves with stalked glands.

10. *R. pumilum*.

Petioles and veins with sessile glands or glandless. 11. *R. inebrians*.

Leaves convolute in bud, stem unarmed; hypanthium tubular.

12. *R. longifolium*.

1. *Ribes Purpusi* Koehne. In the mountains from Wyo. to N. M.—Alt. 5000–10,000 ft.—Cucharas Valley, near La Veta; Ojo; foot-hills west of Ft. Collins; Sierra Blanca; near Steamboat Springs; West Indian Creek; Villa Grove; Grand Lake; Dillon; mountains between Sunshine and Ward; Soldier Cañon; Horsetooth Gulch; Rist Cañon; Dixon Cañon; Cheyenne Cañon.

2. *Ribes valicola* Greene. (*R. saxosum* Coville; not Hook; *R. oxycanthoides* of Coulter's Man.) In the mountains from Mont. and Wash. to Colo. and Calif.—Alt. 8000–9000 ft.—Upper Cañon of the West Mancos; Los Pinos; Cerro Summit; Steamboat Springs.

3. *Ribes leptanthum* A. Gray. In the mountains from Mont. to Colo. and Ariz.—Alt. 6000–10,000 ft.—Bob Creek, West La Plata Mountains; Ute Pass; foot-hills, Sierra Blanca; Buena Vista; North Cheyenne Cañon; Crystal Lake; Manitou; South Cheyenne Cañon; Cañon City; Poncha Pass; Garden of the Gods; Mancos.

4. *Ribes lentum* (Jones) Coville & Rose. (*R. lacustre molle* A. Gray.) In the mountains from Wyo. to Colo. and Calif.—Alt. 8000–12,000 ft.—Mount Ouray; Windy Point; Lake City; Veta; Georgetown; Cameron Pass; Cañon of the Cache la Poudre; near La Plata Post Office; Bob Creek; Pagosa Peak; West Indian Creek; Wahatoya Cañon; near Empire; Seven Lakes; four miles west of Cameron Pass; Telluride; Grand Mesa; Cottonwood Lake; Jack Brook; mountains near Seven Lakes; Pike's Peak; Hahn's Peak; Red Mountain, south of Ouray; headwaters of Clear Creek and alpine ridges east of Middle Park; Empire; near Buffalo Pass, Park Range; Eldora to Baltimore; Berthoud Pass; Graymont.

5. *Ribes parvulum* (A. Gray) Rydb. (*R. lacustre parvulum* A. Gray.) In the mountains from Alb. and Yukon to Colo. and Utah.—Alt. 7000–12,000 ft.—Black Cañon; Ouray; Red Mountain, south of Ouray; Berthoud Pass; Silverton; Big Creek; Anita Peak; Pinkham Creek.

6. *Ribes coloradense* Coville. In the mountains from Colo. to N. M.—Alt. 9000–11,000 ft.—Silverton; Marshall Pass; Slide Rock Cañon; near Pagosa Peak; Sangre de Cristo Creek; Silver Plume; Telluride; Twin Lakes; Berthoud Pass; Cameron Pass; Rabbit-Ear Range, Routt Co.

7. *Ribes Wolfii* Rothrock. (*R. mogollonicum* Greene) In woods from Colo. and Utah to N. M. and Ariz.—Alt. 7500–12,000 ft.—Van Boxle's ranch, above Cimarron; Redcliffe, Eagle Co.; cañons near Ouray; Mt. Abram, Ouray; Box Cañon; Bear Creek Divide; Wahatoya Cañon; Hinsdale Co.; Buffalo Pass, Park Range; Leroux.

8. *Ribes viscosissimum* Pursh. On wooded hillsides from Mont. and Wash. to Colo. and Calif.—Steamboat Springs, Routt Co.

9. *Ribes floridum* L'Her. In wet woods from N. S. and Mont. to Va. and Colo.—Notch Mountain.

10. *Ribes pumilum* Nutt. (*R. cereum* Coulter, in part.) On dry hills from Mont. to N. M. and Ariz.—Alt. 5000–10,000 ft.—Foot-hills west of Ft. Collins; Larimer Co.; Ute Pass, Walsenburg; Colorado Springs; Turkey Creek and tributaries; Cucharas Valley, near La Veta; near Boulder; Horsetooth Gulch; La Porte; Rist Cañon; Howe's Gulch; Soldier Cañon; Stove Prairie; Trinidad; Ute Pass; Beaver Creek.

11. *Ribes inebrians* Lindl. (*R. cereum* Coulter, in part.) On hills from Mont. to N. M. and Utah.—Alt. 5000–11,000 ft.—Ouray; Buena Vista; Cerro Summit; hills about Box Cañon, west of Ouray; Bob Creek, West La Plata Mountains; West Mancos Cañon; mesas near Colorado Springs; Minturn; Lake City; Pike's Peak trail.

12. *Ribes longifolium* Nutt. (*R. aureum* T. & G., mainly; not Pursh.) On the plains and in the foot-hills from S. D. and Wyo. to Kans. and Ariz.—Alt. 4000–7000 ft.—Ft. Collins; near Denver; Steamboat Springs; West Soldier Cañon; Horsetooth Gulch; Manitou; Boulder; Villa Grove; Rocky Mountains.

Family 66. ROSACEAE Juss. ROSE FAMILY.

Hypanthium neither fleshy nor prickly nor strongly constricted at the throat, if at all inclosing the fruit merely loosely investing it.

Carpels few, becoming 2–4-seeded follicles, more or less united at the base and opening along both sutures; shrubs with palmately veined leaves.

1. OPULASTER.

Carpels usually many, rarely few, becoming 1-seeded (rarely 2-seeded) achenes or drupelets.

Carpels becoming more or less fleshy drupelets.

Styles club-shaped; stigmas 2-lobed; receptacle flat; unarmed shrubs with shreddy bark and digitately veined, maple-like leaves.

Drupelets capped by hard hairy cushions; style glabrous; erect shrubs.

2. RUBACE.

Drupelets without cushions; styles hairy; prostrate or reclining shrubs.

3. ORBOBATUS.

Styles filiform, glabrous; stigmas capitate; receptacle hemispherical, conical or nipple-shaped; drupelets without cushions; leaves in our species pinnate and stem prickly.

4. RUBUS.

Carpels dry achenes.

Style articulated to the ovary and deciduous.

Style terminal or nearly so; ovules pendulous and anatropous.

Stamens inserted very near the base of the receptacle on a more or less evident annular thickening.

5. POTENTILLA.

Stamens separated from the receptacle by a wide open space; no indication of an annular thickening.

6. HORKELIA.

Style lateral or basal; ovules not pendulous.

- Style lateral; ovules ascending and amphitropous.
 Achenes glabrous; herbs.
 Achenes numerous; stamens about 20.
 Receptacle neither enlarged in fruit nor becoming pulpy; leaves interruptedly pinnate; petals yellow. 7. ARGENTINA.
 Receptacle much enlarged in fruit and becoming red and pulpy; leaves trifoliate; petals white or pinkish. 8. FRAGARIA.
 Achenes 10-15; stamens 5; leaves trifoliate; petals yellowish. 9. SIBBALDIA.
 Achenes hairy; shrubs with pinnate leaves. 10. DASIPHORA.
 Styles nearly basal; ovules ascending or erect, orthotropous.
 Stamens 5; pistils 5-10; bractlets wanting; leaves twice ternate. 11. CHAMAERHODOS.
 Stamens and pistils numerous; bractlets present; leaves pinnate. 12. DRYMOCALLIS.
 Style not articulated to the ovary, persistent, at least the lower portion.
 Style geniculated above, the upper hairy portion deciduous; herbs. 13. GEUM.
 Style not geniculated above, wholly persistent.
 Petals normally 5 or none.
 Herbs with woody rootstocks and pinnate leaves; bractlets present; carpels numerous. 14. SIEVERSIA.
 Shrubs or trees.
 Bractlets present; carpels numerous with plumose styles. 15. FALLUGIA.
 Bractlets wanting; carpels solitary or few.
 Hypanthium saucer-shaped or hemispherical; carpels 5; flowers panicle. 16. HOLODISCUS.
 Hypanthium funnel-form or tubular; carpels solitary; flowers solitary.
 Petals 5; style not elongated in fruit; calyx persistent; leaves 3-cleft. 17. KUNZIA.
 Petals wanting; style elongated and plumose in fruit; calyx deciduous from the hypanthium; leaves toothed. 18. CERCOCARPUS.
 Petals 8-9; dwarf matted undershrubs with solitary flowers and simple, in ours crenate leaves. 19. DRYAS.
 Hypanthium constricted at the throat, wholly enclosing the achenes.
 Hypanthium dry, turbinate; upper portions armed with hooked prickles; herbs; carpels few; flowers racemose. 20. AGRIMONIA.
 Hypanthium in fruit becoming fleshy; carpels numerous; shrubs with large flowers solitary or in small corymbs. 21. ROSA.

1. OPULASTER Medic. NINE-BARK.

- Carpels 3-5, united only at the base. 1. *O. intermedius*.
 Carpels 2, united at least half their length.
 Bracts obovate or spatulate, often foliaceous and more persistent. 2. *O. Ramaleyi*.
 Bracts linear or linear-oblongate, membranous and caducous.
 Pedicels and hypanthium almost glabrous. 3. *O. glabratus*.
 Pedicels, hypanthium and sepals decidedly stellate. 4. *O. monogynus*.
 1. *Opulaster intermedius* Rydb. (*Physocarpus opulifolius* Coulter, in part.)
 On river banks and hillsides from Ill. and S. D. to Mo. and Colo.—Alt. 4000-7000 ft.—Pike's Peak; North Cheyenne Cañon; Colorado Springs; Lower Boulder Cañon.
 2. *Opulaster Ramaleyi* Aven Nelson. (*O. bracteatus* Rydb.) In the foot-hills of Colo.—Alt. 5000-6000 ft.—New Windsor; Buckthorn Creek, Larimer Co.; Cheyenne Cañon; foot-hills west of Ft. Collins.

3. *Opulaster glabratus* Rydb. Along streams in the mountains of Colo.—Alt. 5000–11,000 ft.—West Spanish Peak; Turkey Creek and tributaries; Rist Cañon; North Poudre; Boulder.

3. *Opulaster monogynus* (Torr.) Kuntze. (*Physocarpus Torreya* Max.) On the mountain tops from S. D. and Wyo. to N. M. and Nev.—Alt. 6000–9000 ft.—Denver; Cheyenne Cañon; Colorado Springs; Flouissant; Upper Bear Creek; Pike's Peak; foot-hills, Larimer Co.; Glen Eyrie; Livermore, Larimer Co.; Idaho Springs; Cascade Cañon; Engelmann Cañon; near Georgetown; Minnehaha; Black Cañon; headwaters of Pass Creek; Stove Prairie Hill; North Poudre; Table Rock; Pennock's mountain ranch; Howe's Gulch; Rist Cañon; Baxter's ranch.

2. RUBACER Rydb. FLOWERING RASPBERRY, SALMON-BERRY.

1. *Rubacer parviflorus* (Nutt.) Rydb. (*Rubus Nutkanus* Moç.) On wooded hillsides from Ont. and Alaska to N. M. and Calif.; also in Mex.—Alt. 6000–9000 ft.—Four-Mile Hill; La Plata Cañon; Steamboat Springs; Redcliffe; Eagle Cliff; Box Cañon, west of Ouray; Ouray; near Pagosa Peak; Fish Creek; Rico; Rabbit-Ear Range, Routt Co.

3. OREOBATUS Rydb.

1. *Oreobatus deliciosus* (James) Rydb. (*Rubus deliciosus* James) On the mountains of Colo.—Alt. 5000–10,000 ft.—Pike's Peak; Manitou; headwaters of Clear Creek; Apex; foot-hills west of Ft. Collins; Colorado Springs; Cheyenne Cañon; near Manitou; Cheyenne Mountain; Turkey Creek and tributaries; Georgetown; Bear Cañon; Ute Pass; Rist Cañon; Howe's Gulch; Palmer Lake; Spring Cañon; Dixon Cañon; Stove Prairie Hill; Horsetooth Gulch; gulch south of Boulder; Engelmann Cañon.

4. RUBUS L. RASPBERRY, BLACKBERRY, BRAMBLE.

Stems, pedicels and petioles glandular bristly, not prickly; fruit red.

1. *R. strigosus*.

Stems, pedicels and petioles more or less prickly, not bristly; fruit black.

2. *R. occidentalis*.

1. *Rubus strigosus* Michx. On hills and in rocky woods from Lab. and Mackenzie to N. J. and Neb.—Alt. 6000–10,000 ft.—Minnehaha; Box Cañon, west of Ouray; Ouray; Manitou; Grayback mining camps and Placer Gulch; Cheyenne Cañon; Chambers' Lake; foot-hills, Larimer Co.; Upper West Mancos Cañon; Campton's ranch; Cache la Poudre; Fish Creek Falls, Routt Co.

2. *Rubus occidentalis* L. In open woods and among bushes from Que. and Minn. to Ga. and Colo.—Locality not given, perhaps doubtful.

5. POTENTILLA L. FIVE-FINGER, CINQUEFOIL.

Flowers many in very leafy cymes; annuals or biennials or short-lived perennials; style fusiform.

I. SUPINAE.

Flowers cymose, but cymes not very leafy, generally rather few-flowered; perennials with a strongly developed rootstock.

Leaves mainly digitate, rarely pinnate with approximate leaflets or with a pair of small leaflets on the petioles.

Leaves or at least the basal ones 5-9-foliolate.

Additional smaller leaflets on the petioles not present.

Plants less than 2 dm. high.

Leaves tomentose at least beneath.

Leaves not tomentose.

Plants more than 2 dm. high.

Additional smaller leaflets on the petioles present.

Leaves 3-foliolate, tomentose beneath.

Leaves manifestly pinnate.

Style not longer than the mature achenes, thickened or glandular below; leaves more or less tomentose, but not necessarily white beneath.

Style much longer than the mature achenes, filiform.

Leaflets approximate, 3-7.

Leaves tomentose beneath.

Leaves not at all tomentose.

Leaflets rather distant 7-21.

Leaves green on both sides and only slightly hairy.

Leaves grayish or whitish, silky or tomentose.

II. CONCINNAE.

III. AUREAE.

IV. GRACILES.

V. SUBJUGAE.

VI. NIVEAE.

VII. MULTIFIDAE.

VIII. RUBRICAULES.

III. AUREAE.

IX. MULTIJUGAE.

X. LEUCOPHYLLAE.

I. SUPINAE.

Achenes with a corky gibbosity on the upper suture; leaves pinnate with 3-5 pairs of leaflets.

1. *P. paradoxa*.

Achenes not gibbous.

Leaves pinnate, with 2 approximate pairs of leaflets; the upper ternate.

2. *P. rivalis*.

Leaves all ternate (or the lower rarely digitately 5-foliolate).

Petals shorter than the sepals; achenes whitish.

Stem diffusely branched, spreading; leaflets cuneate; inflorescence cymose.

3. *P. leucocarpa*.

Stem erect, strict; leaflets broadly obovate; inflorescence falsely racemose.

4. *P. lateriflora*.

Petals about equalling the sepals; stem stout, strict; achenes brownish.

5. *P. monspeliensis*.

II. CONCINNAE.

Middle leaflet sessile.

Leaflets obovate or cuneate, deeply toothed or incised.

6. *P. concinna*.

Leaflets oblong, with entire margins, only 3-toothed (rarely 5-toothed) at the very apex.

7. *P. bicrenata*.

Middle leaflet petioled.

8. *P. quinquefolia*.

III. AUREAE.

Only one species.

9. *P. dissecta*.

IV. GRACILES.

Leaves green on both sides, not at all tomentose beneath.

Leaflets cuneate at the base, usually toothed only above the middle; plants low, usually less than 3 dm. high.

9. *P. dissecta*.

Leaflets oblanceolate, toothed to near the base; plants 3-6 dm. high.

Stem glabrous or appressed-pubescent; leaflets coarsely toothed or cleft halfway to the mid-rib or less.

Slender; leaves thin, not strongly ribbed; inflorescence open; bracts small.

10. *P. jucunda*.

Stout; leaves thick and strongly ribbed; inflorescence dense; bracts conspicuous.

11. *P. Nuttallii*.

Stem with spreading hairs; leaflets cleft to near the mid-rib.

12. *P. brunnescens*.

Leaves more or less tomentose beneath.

Leaves sparingly tomentose and grayish beneath; leaflets dissected about three-fourths to the mid-rib.

13. *P. Bakeri*.

Leaves densely white-tomentose beneath; leaflets merely crenate or toothed.

Lower stem-leaves 5-foliolate; plant 3 dm. or more high.

Hypanthium and calyx not tomentose, as well as the pedicels more or less viscid; pubescence of stem and petioles usually loose.

14. *P. filipes*.

Hypanthium and calyx more or less tomentose, not viscid; pubescence of the stem and petioles usually appressed.

15. *P. pulcherrima*.

Stem-leaves all ternate; plant 1-2 (seldom 3) dm. high.

8. *P. quinquefolia*.

V. SUBJUGAE.

One species.

16. *P. subjuga*.

VI. NIVEAE.

Stem 1-2 dm. high, more or less leafy, several-flowered.

17. *P. nivea*.

Stem less than 1 dm. high, subscapose, usually 1-2 flowered.

18. *P. uniflora*.

VII. MULTIFIDAE.

Pubescence not silvery white.

Plant dark green; branches of inflorescence rather long, erect.

19. *P. atrovirens*.

Plant usually yellowish green; branches of inflorescence short and ascending.

20. *P. pennsylvanica*.

Pubescence silvery white, at least beneath.

Leaves white-silky on both sides; lobes of the leaflets linear.

21. *P. bipinnatifida*.

Leaves greenish above; lobes of the leaflets oblong or lanceolate.

22. *P. platyloba*.

VIII. RUBRICAULES.

Sepals lanceolate to linear, acuminate.

Leaves densely silky or tomentose on both sides.

23. *P. filicaulis*.

Leaves greenish above.

Segments of the leaflets oblong to orbicular in outline.

Stems decumbent or prostrate; segments of the leaves oblong.

24. *P. rubripes*.

Stems ascending; segments of the leaves orbicular or nearly so.

25. *P. minutifolia*.

Segments of the leaflets linear; stems erect.

26. *P. tenerrima*.

Sepals broadly ovate or ovate-triangular, obtusish or abruptly mucronate.

Plant densely cespitose; leaves silky and finely tomentose beneath.

27. *P. saximontana*.

Plants with a few spreading branches; leaves floccose beneath.

6. *P. concinna*.

IX. MULTIJUGAE.

Leaflets dissected to near the mid-rib.

Stem erect, with 1-3 small leaves.

28. *P. pinnatisecta*.

Stem decumbent or ascending, leafy.

29. *P. plattensis*.

Leaflets merely coarsely toothed; stem erect.

30. *R. rupicola*.

X. LEUCOPHYLLAE.

Leaves white-tomentose, floccose or silky, at least beneath.

Bractlets nearly equalling the acute sepals; leaves silky as well as tomentulose; hence shining.

Leaves nearly equally white on both sides; upper leaflets not decurrent.

31. *P. Hippiana*.

Leaves greener above; upper 3 leaflets more or less decurrent on the rachis.

32. *P. propinqua*.

Bractlets much shorter than the acuminate sepals; leaves merely floccose; hence dull.

Leaves thick, densely floccose; pistils numerous.

33. *P. effusa*.

Leaves thin; tomentum sparse and more or less deciduous; pistils few.

34. *P. coloradensis*.

Leaves grayish silky.

Stem stout, erect, 6-7 dm. high; leaflets obovate or oblong, coarsely serrate, the upper decurrent on the rachis.

35. *P. ambigua*.

Stem 1-4 dm. high; leaflets cuneate, toothed at the apex only, conduplicate, none decurrent.

36. *P. crinita*.

1. *Potentilla paradoxa* Nutt. (*P. supina* Am. auth.; not L.) In wet places from Ont. and Wash. to N. M.; also Mex. and western Asia.—Steamboat Lake.

2. *Potentilla rivalis* Nutt. In wet places from Sask. and Ore. to Mex.—Alt. up to 8000 ft.—Lee's Lake; along the Conejos River, north of Antonito; Ft. Collins; Quimby; along the Platte River, Denver; Georgetown; New Windsor.

3. *Potentilla leucocarpa* Rydb. (*P. milligrana* Engelm.; not Dougl.) In wet meadows from Ill. and Wash. to N. M. and Calif.—Poudre Cañon; Middle Park; Steamboat Springs.

4. *Potentilla lateriflora* Rydb. (*P. biennis* Rydb., in part; not Greene) In loose soil from Ass. and B. C. to Colo. and Ariz.—Alt. about 8000 ft.—Gunnison.

5. *Potentilla monspeliensis* L. (*P. norvegica hirsuta* T. & G.) In fields and waste places from Lab. and Alaska to D. C. and Mex.—Alt. up to 8000 ft.—Along Conejos River, north of Antonito; Rist Cañon; Soldier Cañon; Gypsum; La Porte; Ft. Collins; Rocky Ford; near Boulder; Gunnison; Iron-ton Park; Ruxton Park; New Windsor; Pagosa Springs; Green Mountain Falls; Pike's Peak; Placer Gulch; Beaver Creek.

6. *Potentilla concinna* Richardson. (*P. humifusa* Nutt.) Dry hills and mountains from Sask. and Alb. to Colo. and Utah.—Alt. 5000-10,000 ft.—Devil's Causeway; North Park; Empire; Lake City; Georgetown; Cameron Pass; Mt. Abram; Cumberland Mine, La Plata Mountains; Little Kate Mine; West Spanish Peak; Little Veta Mountain; headwaters of Sangre de Cristo Creek; Spicer, Larimer Co.

7. *Potentilla bicrenata* Rydb. Dry mountains of N. M. and Colo.—"Colorado."

8. *Potentilla quinquefolia* Rydb. (*P. nivea subquinata* Lange; *P. nivea pentaphylla* Lehm.) On dry mountains from Greenl. and B. C. to Colo.—Alt. 10,000-14,000 ft.—Cumberland Mine, La Plata Mountains; West Spanish Peak; Mt. Hesperus; Hahn's Peak.

9. *Potentilla dissecta* Pursh. (*P. diversifolia* Lehm.) On hills and mountain sides from Sask. and B. C. to Colo. and Calif.—Alt. up to 13,000 ft.—Lake City; headwaters of Clear Creek; Cameron Pass; Lake City; Caribou; Willis Gulch; Pagosa Springs; Carson; Alpine Tunnel; Buffalo Pass Park; Mt. Princeton; Little Kate Mine; Ouray; Estes Park; Spicer.

Potentilla dissecta glaucophylla (Lehm.) S. Wats. A taller and more glabrous variety.—Boreas; Beaver Creek Cañon; above Beaver Creek; Beaver Creek; camp on Little Beaver; Graymont; Cameron Pass; Lake City; Caribou; Red Mountain; Alpine Tunnel; Silver Plume; Camp Creek.

10. *Potentilla juncunda* A. Nels. In the mountains of Wyo. and Colo.—Alt. up to 10,000 ft.—Chambers' Lake; Beaver Creek; Cameron Pass; Little Kate Mine.

11. *Potentilla Nuttallii* Lehm. (*P. gracilis rigida* S. Wats.) In mountain valleys from Sask. and B. C. to Colo. and Calif.—Sheephorn Divide, Middle Park; Grizzly Creek; northwest of North Park.

12. *Potentilla brunnescens* Rydb. In dry mountain meadows from Mont. to Colo.—Alt. about 8000 ft.—Columbine; Grizzly Creek; Steamboat Springs; Walden.

13. *Potentilla Bakeri* Rydb. In the mountains of Colo.—Alt. 8000–9000 ft.—Grizzly Creek; southwest North Park; Doyle's; Gunnison watershed.

14. *Potentilla filipes* Rydb. In the mountains of Colo.—Alt. 5000–10,000 ft.—Forks of Poudre and Big South; above Ouray; along Bear River; Como; Chambers' Lake; Dolores.

15. *Potentilla pulcherrima* Lehm. In mountain meadows from Sask. and Alb. to N. M. and Nev.—Alt. 8000–10,000 ft.—Lake City; mountains above Denver; Larimer Co.; near Empire; Como; Silverton; Beaver Creek; along the Conejos River, north of Antonito; Rico; Stove Prairie Hill, Larimer Co.; Campton's ranch; Dolores; headwaters of Clear Creek.

16. *Potentilla subjuga* Rydb. Mountains of Colo.—Alt. 8000–9000 ft.—Near Empire.

17. *Potentilla nivea* L. In alpine-arctic situations from Lab. and Alaska to Colo.; also in Europe and Asia.—Alt. 10,000–13,000 ft.—Devil's Causeway; Empire; Ouray; West Spanish Peak; Cumberland Mine, La Plata Mountain; mountains of Estes Park.

18. *Potentilla uniflora* Ledeb. In alpine-arctic situations from Greenl. and Alaska to Colo. and Ore.—Alt. 10,000–13,000 ft.—High mountains about Empire; Hinsdale Co.; Cameron Pass; Estes Park; Boreas.

19. *Potentilla atrovirens* Rydb. On plains and hills from Minn. and Wyo. to Colo.—Williams' Cañon, Pike's Peak.

20. *Potentilla pennsylvanica strigosa* Pursh. On plains from Hudson Bay and Alb. to Kans. and N. M. (the true *P. Pennsylvanica* L. is not found in Colo.).—Alt. up to 8000 ft.—Antonito; West Mancos Cañon; Central City; Empire.

Potentilla pennsylvanica arachnoidea Lehm. On high plains from Mont. and Utah to N. M. and Ariz.—Alt. 5000–8000 ft.—Lake City; Sangre de Cristo Creek; Chicken Creek; Ouray; near Boulder; mountains of Estes Park.

21. *Potentilla bipinnatifida* Dougl. On plains from Sask. and Alb. to Neb. and Colo.—Alt. 4000–10,000 ft.—Larimer Co.; Como; Antonito; Higho; Ute Pass; Indian Creek Pass; Gunnison.

22. *Potentilla platyloba* Rydb. (*P. bipinnatifida platyloba* Rydb.) On plains from Hudson Bay and Alb. to Neb. and Colo.—Mountain View; Gunnison; Pitkin; Empire.

23. *Potentilla filicaulis* (Nutt.) Rydb. (*P. effusa filicaulis* Nutt.) In the mountains from Colo. to Ida.—Beaver Creek.

24. *Potentilla rubripes* Rydb. (*P. rubricaulis* Rydb., mainly; not Lehm.) In the higher mountains from Alb. to Colo.—Alt. 10,000–13,000 ft.—Estes Park; Mt. Abram, Ouray; Pike's Peak; Little Kate Mine, La Plata Mountains; Cameron Pass; Berthoud Pass; Rabbit-Ears, Larimer Co.

25. *Potentilla minutifolia* Rydb. On the higher peaks of Colo.—Alt. 9000–13,000 ft.—Graymont; Georgetown; Saddle, Pike's Peak; mountains of Estes Park; Cumberland Mine; Eldora to Baltimore.

26. *Potentilla tenerrima* Rydb. On the higher mountains of Colo.—Alt. 10,000–13,000 ft.—Pike's Peak; West Spanish Peak.

27. *Potentilla saximontana* Rydb. On the higher peaks of Colo.—Alt. 10,000–13,000 ft.—Pike's Peak; West Spanish Peak.

28. *Potentilla pinnatisecta* (S. Wats.) Rydb. In the mountains from Alb. to Colo. and Utah.—Alt. 8000–12,000 ft.—Little Kate Mine, La Plata Mountains; mountains of Estes Park.

29. *Potentilla plattensis* Nutt. In mountain meadows from Sask. to Colo. and Utah.—Alt. 8000–10,000 ft.—Platte River, South Park; Tobe Miller's ranch; Walden; Gunnison; Ojo; Placer Gulch; headwaters of Sangre de Cristo Creek; Buena Vista.

30. *Potentilla rupincola* Osterh. Mountains in Colo.—Dale Creek, Larimer Co.

31. *Potentilla Hippiana* Lehm. On plains and in meadows from Minn., Sask. and Alb. to N. M. and Ariz.—Alt. 4000–10,000 ft.—Near Empire; Trapper's Lake; Estes Park; Willow Creek; Georgetown; Gunnison; Colorado Springs; South Park; Chambers' Lake; Upper Laramie River; Forrester's ranch, Larimer Co.; North Park; Indian Creek Pass.

32. *Potentilla propinqua* Rydb. (*P. Hippiana diffusa* Lehm.) In meadows from Colo. to N. M. and Ariz.—Alt. 6000–10,000 ft.—Rico; Como; near Narrows; Durango; Chambers' Lake; near Pagosa Peak; Mancos; Pagosa Springs; Ruxton Dell; Chicken Creek; Pitkin; Mt. Hesperus; North Park; Grizzly Creek, southwest of North Park.

33. *Potentilla effusa* Dougl. On plains and hills from Ass. and Mont. to N. M.—Alt. 5000–10,000 ft.—Crow Creek; near Empire; Bosworth's ranch; Poudre flats, above Ft. Collins; Estes Park, Larimer Co.; Table Rock; Moore's ranch; Manitou; Cameron Pass; Cascade; Indian Creek Pass; Sangre de Cristo Creek; near Boulder.

34. *Potentilla coloradensis* Rydb. In the mountains of Colo.—Alt. 8000–10,000 ft.—Georgetown; South Park; Estes Park, Larimer Co.; Empire; Chambers' Lake; Minnehaha; Silver Plume; Como.

35. *Potentilla ambigens* Greene. In the mountains of Colo. and N. M.—

36. *Potentilla crinita* A. Gray. On dry hills of Colo., Utah, N. M. and Ariz.—Piedra.

6. *HORKELIA* C. & S.

1. *Horkelia Gordonii* Hook. On dry mountains from Mont. and Wash. to Colo. and Calif.—Alt. about 11,000 ft.—Buffalo Pass; summit of North Park Range, Routt Co.; Ethel Peak.

7. ARGENTINA Lam. SILVER-LEAF, GOOSE-TANSY.

Leaves green and glabrate above.

1. *A. anserina*.

Leaves silvery-white on both sides.

2. *A. argentea*.

1. *Argentina anserina* (L.) Rydb. (*Potentilla anserina* L.) Wet soil from Greenl. and Alaska to N. J., Colo. and Calif.—Alt. 4000-10,000 ft.—Bear River; Steamboat Springs; Ft. Collins; Como; Platte Cañon.

2. *Argentina argentea* Rydb. (*A. anserina concolor* Rydb.; not *Potentilla anserina concolor* Ser.) In wet mountain meadows from Ass. and Wash. to N. M. and Ariz.—Black's Lake; Upper Sangre de Cristo Creek.

8. FRAGARIA L. STRAWBERRY.

Pubescence of the scape and petioles spreading or reflexed; achenes superficial.

Calyx in fruit spreading; scape usually with a leafy bract. 1. *F. bracteata*.

Calyx in fruit reflexed; scape generally without a leafy bract.

2. *F. americana*.

Pubescence of the scape and petioles appressed or ascending; achenes set in pits. Plant not glaucous; scape densely strigose.

Leaflets over 3 cm. long, very veiny beneath; runners numerous.

3. *F. prolifica*.

Leaflets 1-3 cm. long, not very veiny; runners few.

4. *F. pumila*.

Plant more or less glaucous.

Leaves thin.

Leaflets obovate; scape several-flowered.

5. *F. glauca*.

Leaflets oblong-cuneate; scape 1-4-flowered.

6. *F. pauciflora*.

Leaves rather thick, firm; leaflets oblong-cuneate.

7. *F. ovalis*.

1. *Fragaria bracteata* Heller. In meadows and open copses from Mont. and B. C. to N. M. and Calif.—Alt. 8000-11,000 ft.—Minnehaha; Little Veta Mountain; Pike's Peak; Georgetown.

2. *Fragaria americana* (Porter) Britton. (*F. vesca* Pursh, in part; not L.) In meadows and woods and on hillsides from Newf. and Man. to Va. and N. M.—Dillon Cañon; Pennock's mountain ranch; Rist Cañon; Boulder; Ute Pass.

3. *Fragaria prolifica* Baker & Rydb. In the mountains of Colo.—Alt. 7000-10,000 ft.—Cameron Pass; Grayback mining camps and Placer Gulch; Pike's Peak; Seven Lakes; bank of Poudre; near Silverton; Como; Chambers' Lake; Columbine; Red Mountain; Breckenridge; Wahatoya Cañon; Pike's Peak; Cheyenne Cañon.

4. *Fragaria pumila* Rydb. On hillsides from S. D. and Wyo. to Colo.—Pike's Peak; Gunnison; Seven Lakes.

5. *Fragaria glauca* (S. Wats.) Rydb. In meadows and open woods from Mackenzie and Mont. to S. D., Colo. and Nev.—Alt. 8000-11,000 ft.—Pike's Peak; Veta Mountain; Cucharas Valley, near La Veta; Pass Creek; East Indian Creek; Andrew's ranch, Larimer Co.; Little Kate Basin, La Plata Mountains; bank of Poudre; Howe's Gulch; Como.

6. *Fragaria pauciflora* Rydb. On hills from Hudson Bay and Alb. to Colo. and Utah.—Alt. 7000-9000 ft.—North Boulder Peak; below Halfway House, Pike's Peak; Andrew's Shetland ranch; North Park, near Teller; Pennock's mountain ranch; along the Conejos River, north of Antonito; Minnehaha.

7. *Fragaria ovalis* (Lehm.) Rydb. (*Potentilla ovalis* Lehm.; *Fragaria firma* Rydb.) On dry hills from Colo. and Utah to Cent. Mex.—Bear Creek Divide, La Plata Mountains.

9. **SIBBALDIA** L.

1. *Sibbaldia procumbens* L. On alpine peaks and in arctic regions from Greenl. and Alaska to N. H., Colo. and Calif.; also in Europe and Asia.—Alt. 10,000–14,000 ft.—Massif de l'Arapahoe; Red Mountain, south of Ouray; Silver Plume; Mt. Harvard; West Spanish Peak; Tennessee Pass, seven miles west of Leadville; near Pagosa Peak; Boreas; Cameron Pass; Little Kate Basin, La Plata Mountains; Beaver Creek; Leroux Creek; Rabbit-Ear Range; Berthoud Pass.

10. **DASIPHORA** Raf. SHRUBBY CINQUEFOIL.

1. *Dasiphora fruticosa* (L.) Rydb. (*Potentilla fruticosa* L.) In meadows and on rocks from Lab. and Alaska to N. J., N. M. and Calif.—Alt. about 10,000 ft.—Vicinity of Como; North Park; Berthoud Pass.

11. **CHAMAERHODOS** Bunge.

1. *Chamaerhodos erecta* (L.) Bunge. On dry plains from Sask. and Alaska to Colo.—Alt. up to 9000 ft.—South Park, southeast of Jefferson.

12. **DRYMOCALLIS** Tourr.

Petals white; leaves densely and coarsely hairy.

1. *D. arguta*.

Petals yellow; leaves sparingly and finely pubescent.

Corolla 15–20 mm. in diameter; petals much exceeding the sepals.

2. *D. fissa*.

Corolla 10–15 mm. in diameter; petals slightly if at all exceeding the sepals.

3. *D. glandulosa*.

1. *Drymocallis arguta* (Pursh) Rydb. On prairies, plains, meadows and hillsides from N. B. and Mackenzie to D. C. and Colo.—Table Rock; Steamboat Springs.

2. *Drymocallis fissa* (Nutt.) Rydb. (*Potentilla fissa* Nutt.) In the mountains from Mont. to Colo.—Alt. 6000–12,000 ft.—Near Narrows, Rist Cañon; Horsetooth Gulch; Dixon Cañon; Beaver Creek; Table Rock; Empire; Bear Creek Cañon; Wyoming State line; Pennock's mountain ranch; Beaver Creek; summit of North Park Range, Larimer Co.

3. *Drymocallis glandulosa* (Nutt.) Rydb. (*Potentilla glandulosa* Nutt.) In the mountains from Alb. and B. C. to S. D., N. M. and Calif.—Leroux Creeks, Delta Co.; Rist Cañon.

13. **GEUM** L. AVENS.

Petals yellow, clawless.

Upper internode of the style long-hairy; lower not glandular; petals 5–7 mm. long.

1. *G. strictum*.

Upper internode of the style sparingly short-hairy; lower more or less glandular-puberulent; petals 4–5 mm. long.

2. *G. oregonense*.

Petals pink or purplish, more or less clawed.

3. *G. rivale*.

1. *Geum strictum* Ait. In low meadows and among bushes from Newf. and B. C. to Pa., Mo. and Mex.—Alt. 4000–10,000 ft.—Headwaters of Sangre de Cristo Creek; Mancos; Stove Prairie, Larimer Co.; Moon's ranch; Buena Vista; Victoria; Piedra; Gunnison; Parlin, Gunnison Co.; Silver Plume;

Soldier Cañon; Graymont; Ft. Collins; Happy Hollow; Elk Cañon; Bosworth's ranch; Boulder.

2. *Geum oregonense* (Scheutz) Rydb. (*G. urbanum oregonense* Scheutz; *G. macrophyllum* Coulter, in part; not Willd.) In mountain meadows from Mackenzie and B. C. to N. M. and Calif.—Alt. 6000–10,000 ft.—La Plata Cañon; Veta Pass; Marshall Pass; Cascade Cañon; Chicken Creek, west of Mt. Hesperus; Grizzly Creek; Chambers' Lake; White River Plateau; Hounold; Yampa; Victoria; Iron-ton Park, nine miles south of Ouray; Mancos; Castle Cañon; Arapahoe Pass; Elk Cañon; Beaver Creek; Rico; foothills, Larimer Co.; Medicine Bow Mountains; Arapahoe Pass; Empire; Eldora to Baltimore; Steamboat Springs.

3. *Geum rivale* L. In swamps and wet meadows from Newf. and B. C. to N. J. and Colo.—Alt. 8000–9000 ft.—Estes Park; Twin Lakes; headwaters of Sangre de Cristo Creek; Indian Creek Pass; Victoria; Parlin, Gunnison Co.; Iron-ton Park, nine miles south of Ouray; Crystal Park; Empire; Walden.

14. SIEVERSIA R. Br. MOUNTAIN AVENS.

Petals light purple; styles in fruit much elongated, plumose.

1. *S. ciliata*.

Petals yellow; styles scarcely elongating in fruit, appressed hairy.

2. *S. turbinata*.

1. *Sieversia ciliata* (Pursh) Don. (*Geum ciliatum* Pursh; *G. triflorum* Pursh) On hills from Lab. and B. C. to N. Y. and Calif.; also in Mex.—Alt. 8000–12,000 ft.—Como, South Park; Mt. Harvard; Chicken Creek, West La Plata Mountains; North Park; Twin Lakes; Pike's Peak; Pagosa; near Graymont; Marshall Pass; Van Boxle's ranch, above Cimarron; west of Ouray; Red Mountain road, south of Ouray; Dead Lake; Palsgrove Cañon; Arapahoe Pass; on the Michigan; Big South; near Silverton; Beaver Creek.

2. *Sieversia turbinata* (Rydb.) Greene. (*Geum turbinatum* Rydb.; *G. Rossii* T. & G.; not Ser.) On the higher peaks from Wyo. to N. M. and Ariz.—Alt. 10,000–14,000 ft.—Gray's Peak; Uncompahgre Peak; Cameron Pass; Pike's Peak; West Spanish Peak; near Pagosa Peak; Cumberland Basin, La Plata Mountains; Bear Creek Divide, West La Plata Mountains; Flat Top Mountains; Alpine Tunnel; Carson; Beaver Creek; Boreas; Devil's Causeway; Graymont; Berthoud Pass; Ethel Peak.

15. FALLUGIA Endl.

1. *Fallugia acuminata* (Woot.) Rydb. (*F. paradoxa* Coult., in part; and v. *acuminata* Woot.) On dry hills from Colo. and Utah to Tex and Ariz.—Alt. 8000–9000 ft.—Sangre de Cristo Creek; Cimarron.

16. HOLODISCUS Max.

Leaf-blades broadly rounded ovate-spatulate, more or less double-toothed, with rounded teeth.

1. *H. dumosus*.

Leaf-blades oval or obovate, with simple ovate teeth.

Leaf-blades 1.5–4 cm. long; panicle open, with spreading or reflexed, long branches.

2. *H. australis*.

Leaf-blades 1–1.5 cm. long; panicle contracted, with short few-flowered branches.

3. *H. microphyllus*.

1. *Holodiscus dumosus* (Nutt.) Heller. (*Spiraea dumosa* Nutt.) On hills and mountains from Wyo. and Utah to Colo. and Ariz.—Alt. 5000-9000 ft.—Cheyenne Mountain; near Georgetown; Grand Junction; Glenwood Springs; Idaho Springs; Black Cañon; southeast of Ouray; Ragged Mountain, Gunnison Co.; Ute Pass; North Cheyenne Cañon; vicinity of Pine Grove; Empire.

2. *Holodiscus australis* Heller. On hills from Colo. to N. M. and Ariz.—Alt. 6000-9000 ft.—Colorado Springs; Sangre de Cristo Creek; Cheyenne Cañon; Georgetown; Minnehaha.

3. *Holodiscus microphyllus* Rydb. On dry hills from Ida. and Ore. to Colo. and Calif.—Alt. about 9000 ft.—Chicken Creek; Mt. Harvard.

17. *KUNZIA* Spreng.

1. *Kunsia tridentata* (Pursh) Spreng. (*Purshia tridentata* DC.) On dry hills from Mont. and Wash. to N. M. and Calif.—Alt. 7000-8000 ft.—Livermore, Larimer Co.; Dolores; Walcott; divide road to Steamboat Springs; Pearl; between Pallas and Sydney; Rist Cañon; Stove Prairie Hill; Horsetooth Gulch; north of Poudre; Pinkham Creek.

18. *COLEOGYNE* Torr.

1. *Coleogyne ramosissima* Torr. From southwestern Colo. and Nev. to Ariz. and Calif.—Alt. 5250 ft.—Near Hovenweep Castle (*Brandegge*).

19. *CERCOCARPUS* H. B. K. MOUNTAIN HOLLY.

1. *Cercocarpus parvifolius* Nutt. On hills from S. D. and Mont. to N. M. and Utah.—Alt. 5000-10,000 ft.—Golden; Colorado Springs; Boulder; Cerro Summit; Manitou; Cucharas River, above La Veta; Livermore, Larimer Co.; Mancos; Trail Glen, Pike's Peak; North Cheyenne Cañon; foot-hills, Larimer Co.; Horsetooth Gulch; gulch west of Pennock's; Rist Cañon; Pennock's mountain ranch; Poudre Cañon; Trinidad; Ft. Collins; Eldora to Baltimore.

20. *DRYAS* L.

1. *Dryas octopetala* L. On alpine peaks and in arctic regions from Greenl. and Alaska to N. H., Colo. and Utah.—Alt. 11,000-14,000 ft.—Mt. Bartlett, Robinson; Bottomless Pit; Silver Plume; Mt. Harvard; mountains south of Ward; Front Range, Larimer Co.; above Beaver Creek; Cameron Pass.

21. *AGRIMONIA* L. AGRIMONY.

1. *Agrimonia Brittoniana occidentalis* Bickn. Among bushes from S. D. and Wyo. to N. M. and Ariz. The type-species extends east to Que. and W. Va.—Alt. about 5000 ft.—Ft. Collins; North Cheyenne Cañon; Poudre flats; Table Rock; Redstone.

22. *ROSA* L. ROSE, BRIER.

Infrastipular spines not present.

Stems bristly or prickly.

Flowers corymbose at the end of the stems or of almost erect branches.

Leaf-blades glabrous; stipules, leaf-stalks and sepals more or less glandular.

1. *R. arkansana*.

Leaf-blades densely pubescent, at least beneath.

2. *R. pratincola*.

Flowers solitary at the ends of spreading branches.

Leaflets finely but distinctly pubescent beneath.

Leaflets rather firm, coarsely serrate; fruit spherical or nearly so.

3. *R. Sayi*.

Leaves thin, sharply serrate; fruit elongated-ellipsoid.

4. *R. Engelmannii*.

Leaflets glabrous; fruit rounded-obovate or spherical.

5. *R. melina*.

Stem unarmed.

11. *R. Bakeri*.

Infrastipular spines present.

Hypanthium and fruit bristly.

6. *R. Underwoodii*.

Hypanthium and fruit glabrous.

Leaflets glabrous or nearly so.

Spines curved.

Leaflets 1-2 cm. long; spines stout; fruit 1 cm. or less in diameter.

7. *R. manca*.

Leaflets 2-3.5 cm. long; fruit 1-1.5 cm. in diameter.

Spines slender; leaves not bluish green, thin.

8. *R. melina*.

Spines stout; leaves bluish green, thick.

9. *R. pandorana*.

Spines straight or nearly so.

10. *R. Macounii*.

Leaflets decidedly pubescent beneath.

Fruit over 1 cm. broad; leaflets large; flowers solitary; spines stout.

11. *R. Bakeri*.

Fruit less than 1 cm. broad; spines weak, slightly curved or straight; flowers often corymbose.

Petioles and stipules densely glandular.

12. *R. Fendleri*.

Petioles not glandular; stipules merely glandular-toothed or entire.

Spines very slender and straight.

13. *R. aciculata*.

Spines stouter and somewhat curved.

14. *R. Maximilliani*.

1. *Rosa arkansana* Porter. In the Arkansas Cañon of Colo.

2. *Rosa pratincola* Greene. (*R. Arkansana* S. Wats.; also Coult. Man.; not Porter.) On prairies and plains from Minn. and Alb. to Kans. and Colo.—Alt. 4000-6000 ft.—Veta Pass; Colorado Springs.

3. *Rosa Sayi* Schweinitz. On hills and mountains, in open woods, from Que. and Alb. to Mich. and Colo.—Alt. 5000-10,000 ft.—North Cheyenne Cañon; Cottonwood Lake; Ruxton Park, Pike's Peak; Front Range, Larimer Co.; Blue River, above Kremmling; Minnehaha; Hounold; Boulder; Columbine; Marshall Pass; falls of Poudre; west of Steamboat Springs; Campton's ranch; Beaver Creek; Horsetooth Mountain; gulch west of Pen-nock's; Boulder; Eldora to Baltimore.

4. *Rosa Engelmannii* S. Wats. In open woods from Upper Mich. and N. D. to Tex. and Colo.—Alt. up to 9000 ft.—Manitou; headwaters of Pass Creek; Minnehaha Falls.

5. *Rosa Underwoodii* Rydb. In cañons of Colo.—Alt. 8000-9000 ft.—Box Cañon, west of Ouray; La Plata Cañon.

6. *Rosa manca* Greene. In the mountains of Colo.—Alt. 7500-9000 ft.—Mancos; southeast of Ouray.

7. *Rosa melina* Greene. In the mountains of Colo. and Wyo.—Alt. 6000-10,000 ft.—Chambers' Lake; West Spanish Peak; southeast of Ouray; Cerro Summit; Black Cañon.

8. *Rosa pandorana* Greene. In the mountains of Colo.—Pandora.

9. *Rosa Macounii* Greene. In valleys and along streams from S. D. and Alb. to Kans. and Colo.—Colorado Springs; Pike's Peak; Mancos; New Windsor; North Cheyenne Cañon; Horsetooth Mountain.

10. *Rosa Bakeri* Rydb. In cañons and on hillsides from Mont. and Ida. to Colo.—Alt. 7500-9000 ft.—Box Cañon, west of Ouray; Dix Post Office; Four-Mile Hill, Routt Co.; Parlin.

11. *Rosa Fendleri* Crepin. In valleys and along streams from S. D. and Mont. to N. M. and Ariz.—Alt. 5000-9000 ft.—Blue River, above Kremmling; Golden; Twin Lakes; mountains between Sunshine and Ward; Boulder.

12. *Rosa aciculata* (Cockerell) Rydb. (*R. blanda aciculata* Cockerell) In rich valleys of Colo and N. M.—Alt. 6000-10,000 ft.—Walsenburg; mountains between Sunshine and Ward.

13. *Rosa Maximiliani* Nees. (? *Rosa Woodsii* Lindl.) In valleys and on foot-hills from Sask. and Wash. to Colo. and Utah.—Alt. 6000-9000 ft.—Gunnison; Blue River, above Kremmling; foot-hills, Larimer Co.; Sangre de Cristo Creek; Pagosa Springs; southeast of Ouray; New Windsor; Horsetooth Mountain; Steamboat Springs.

Family 67. **MALACEAE** Small. APPLE FAMILY.

Cavities of the ovary becoming twice as many as the styles by a false, complete or incomplete partition; leaves simple, toothed.

Styles 5; flowers racemose.

1. AMELANCHIER.

Styles 2; flowers solitary or in sessile 2-3-flowered corymbs.

2. PERAPHYLLUM.

Cavities of the ovary as many as the styles; flowers in corymbiform, compound cymes.

Leaves simple, but more or less lobed; ovules solitary in each carpel.

3. CRATAEGUS.

Leaves pinnate; ovules 2 in each carpel.

4. SORBUS.

1. **AMELANCHIER** L. JUNE-BERRY.

Leaf-blades obtuse to truncate at the apex.

Leaf-blades orbicular or nearly so, truncate at the apex.

Mature leaves glabrous or sparingly and loosely villous.

Whole plant perfectly glabrous; bud-scales glabrous.

1. *A. polycarpa*.

Inflorescence and lower surface of the leaves white-villous when young; bud-scales hairy.

Petals 12-15 mm. long; mature leaves perfectly glabrous.

Leaf-blades elliptic.

2. *A. elliptica*.

Leaf-blades suborbicular or broadly oval.

3. *A. alnifolia*.

Petals about 8 mm. long; mature leaves often somewhat villous beneath.

4. *A. oreophila*.

Mature leaves finely pubescent on both sides, or rarely glabrate above.

5. *A. Bakeri*.

Leaf-blades oval or obovate, obtuse or rounded at the apex, more or less glaucous beneath, entire or slightly toothed.

6. *A. prunifolia*.

Leaves more or less ovate, acute.

7. *A. rubescens*.

1. *Amelanchier polycarpa* Greene. Hills of Colo. and Wyo.—Alt. 7000-11,000 ft.—Piedra; Mt. Abram, Ouray; Hounold; Twin Lakes; Bob Creek, west of La Plata Mountains; Cerro Summit; Ojo.

2. *Amelanchier elliptica* A. Nels. Hills from S. D. to Colo.—Alt. 6000–8000 ft.—Cerro Summit; Crystal Creek; Beaver Creek.

3. *Amelanchier alnifolia* Nutt. Dry hills and rolling plains from N. D. and Mont. to Colo. and Utah.—Alt. 4000–8000 ft.—Poverty Ridge, near Cimarron; Cerro Summit; Hounold; Glenwood Springs; Horsetooth Gulch; Hounold; Central City; Four-Mile Hill; Parlin; Pallas; Pandora.

4. *Amelanchier oreophila* A. Nelson. Hills of Wyo. and Colo.—Alt. 5000–8000 ft.—Willow Creek; Camp Creek; Ojo; hills southeast of La Veta; Van Boxle's ranch, above Cimarron; Los Pinos (Bayfield); Cottonwood Lake; City Creek Cañon; Minturn.

5. *Amelanchier Bakeri* Greene. Dry hills of Colo.—Alt. 6000–8000 ft.—Cedar Creek; Mancos; Los Pinos (Bayfield); Wolcott; Twin Lakes.

6. *Amelanchier prunifolia* Greene. Dry hills and mountains of Colo. and Utah.—Alt. 4000–8000 ft.—Mancos; Cerro Summit.

7. *Amelanchier rubescens* Greene. Dry hills of Colo. and N. M.—Between Rife and Meeker; Cedar Creek.

2. PERAPHYLLUM Nutt.

1. *Peraphyllum ramosissimum* Nutt. Dry hills and mountains from Ore. to Colo. and Calif.—Alt. 6500–8000 ft.—Mancos; Los Pinos (Bayfield); Cerro Summit; Cimarron; Durango; Dolores.

3. CRATAEGUS L. HAWTHORN.

Inflorescence pubescent; leaves hairy beneath, at least on the veins.

Leaf-blades orbicular or broadly obovate, abruptly contracted at the base, 5–7 cm. wide, less distinctly lobed, toothed to near the base.

1. *C. coloradensis*.

Leaf-blades obovate or rhombic, with a cuneate base, 5–9 lobed, with triangular acute lobes, 3–5 cm. wide.

2. *C. occidentalis*.

Inflorescence glabrous; leaves glabrous beneath.

Leaf-blades serrate or incised; fruit 8–10 mm. broad.

Leaf-blades rhombic, incisedly lobed with acute serrate lobes.

3. *C. cernonis*.

Leaf-blades oblanceolate or rhombic-oblanceolate, merely irregularly serrate.

4. *C. Wheeleri*.

Leaf-blades crenate; fruit 6–7 mm. long.

5. *C. saligna*.

1. *Crataegus coloradensis* Aven Nelson. Cañons of Colo.—Alt. 5000–6000 ft.—Colorado Springs; Boulder.

2. *Crataegus occidentalis* Britton. River-banks from N. D. and Mont. to Neb. and Colo.—Alt. 4000–6000 ft.—Golden; foot-hills, Larimer Co.; Boulder; Lower Boulder Cañon; Horsetooth Gulch.

3. *Crataegus cernonis* A. Nels. Along streams in Colo.—Alt. 5000–8000 ft.—Colorado Springs; Larin; Golden; Livermore; Boulder; Cerro Summit.

4. *Crataegus Wheeleri* A. Nels. Along streams from Wyo. to Colo. and Utah.—Alt. about 6000 ft.—Wolcott; Steamboat Springs; between Pallas and Sydney; Steele Cañon; Villa Grove; Dix; between Meeker and Craig; between Rife and Meeker; Spring Creek, above Uncompahgre River.

5. *Crataegus saligna* Greene. Hillsides of Colo.—Alt. up to 7000 ft.—Cimarron; Gypsum Creek Cañon; Meeker; Wolcott; Gunnison; Parlin.

4. **SORBUS** L. MOUNTAIN ASH.

1. *Sorbus scopulina* Greene. (*Pyrus sambucifolia* T. & G.; not C. & S.) In moist ground and hillsides from Alb. and Wash. to Colo. and Utah.—Alt. 5000–10,000 ft.—Near Ouray; Upper La Plata Cañon; Four-Mile Hill, Routt Co.; Pagosa Peak; Box Cañon, west of Ouray; Victoria; North Cheyenne Cañon; west of Palmer Lake; Buffalo Pass; Empire; Rabbit-Ear Range, Routt Co.

Family 68. **AMYGDALACEAE** Reichenb. PLUM FAMILY.1. **PRUNUS** L. PLUMS, CHERRIES.

Flowers in lateral scaly umbels or corymbs, expanding with or before the leaves.

Pits of the fruit flattened; leaves convolute in vernation. 1. *P. americana*.

Pits globose, not flattened; leaves conduplicate in vernation.

Low, decumbent shrubs; inflorescence strictly sessile and umbel-like.

2. *P. Besseyi*.

Erect shrubs or trees; inflorescence corymbiform, more or less peduncled.

3. *P. pennsylvanica*.

Flowers in long racemes, ending leafy branches of the season.

4. *P. melanocarpa*.

1. *Prunus americana* Marsh. Along streams from N. Y. and Mont. to Fla. and Colo.—Alt. 4000–7000 ft.—Boulder; foot-hills of Larimer Co.; Walsenburg; plains near Denver; gulch west of Dixon Cañon; vicinity of Horsetooth; Rist Cañon; Horsetooth Gulch; Trinidad; Cache la Poudre; Manitou.

2. *Prunus Besseyi* Bailey. On sand-hills from N. D. to Kans. and Colo.—Alt. 4000–5500 ft.—Ft. Collins; foot-hills west of Ft. Collins; north of La Porte; Horsetooth Mountain; Black's Lake.

3. *Prunus pennsylvanica* L. f. In rocky woods and on hillsides and along streams from Newf. and N. D. to Ga. and Colo.—Alt. 4000–9500 ft.—Estes Park, Larimer Co.; Ft. Collins; Minnehaha; gulch west of Pennock's; Pike's Peak; Rist Cañon; Stove Prairie Hill; Redstone; mountains between Sunshine and Ward; Eldora to Baltimore; Manitou.

4. *Prunus melanocarpa* (A. Nels.) Rydb. (*P. demissa* Torr., in part; not Walp.; *Cerasus demissa melanocarpa* A. Nels.) On hillsides from N. D., Alb., and B. C. to N. M. and Calif.—Alt. 4000–8000 ft.—Lake City; foot-hills, Larimer Co.; Estes Park; Mancos; Cheyenne Cañon; butte, five miles southwest of La Veta; Cucharas River, below La Veta; Dillon Cañon; Trinidad; Ft. Collins; Cache la Poudre; Bosworth's ranch; gulch west of Pennock's; Horsetooth Gulch; Dixon Cañon; Purgatory River, Trinidad; Pinkham Creek.

Family 69. **MIMOSACEAE** Reichenb. MIMOSA FAMILY.

Valves of the pod not separating from the continuous margin, not prickly; stems erect, unarmed. 1. *ACUAN*.

Valves of the pod separating from the continuous margin; pod 4-angled, prickly; stems prostrate, prickly. 2. *MORONGIA*.

1. ACUAN Medic. PRAIRIE MIMOSA.

1. *Acuan illinoensis* (Michx.) Kuntze. (*Desmanthus brachylobus* Benth.)
In rich bottom lands from Ind. and S. D. to Fla., Tex. and Colo.—Sterling.

2. MORONGIA Britton. SENSITIVE-BRIER.

1. *Morongia uncinata* (Willd.) Britton. (*Schrankia uncinata* Willd.) On
prairies from Ill. and S. D. to Fla. and Tex.—Exact locality not given.

FAMILY 70. CASSIACEAE Link. SENNA FAMILY.

Leaves simply pinnate; corolla very irregular; one of the lateral petals (standard)
and the lowest petal larger than the rest.

Leaves twice pinnate; corolla regularly zygomorph, the upper petal only differing
materially from the rest.

1. CHAMAECRISTA.

2. HOFFMANSEGGIA.

1. CHAMAECRISTA Moench.

1. *Chamaecrista fasciculata* (Michx.) Greene. (*Cassia fasciculata* Michx.;
C. Chamaecrista Walt.; not L.) In prairies from Me. and S. D. to Fla., Tex.
and Colo.—Denver.

2. HOFFMANSEGGIA Cav.

Leaves, flowers and pods with black glandular dots; pods short, 2-2.5 cm. long,
straight on the back or nearly so.

1. *H. Jamesii*.

Dark glandular dots none; pods 3-4 cm. long, strongly arcuate.

2. *H. drepanocarpa*.

1. *Hoffmanseggia Jamesii* Torr. In dry soil from Colo. to Tex. and Ariz.
—Alt. 4000-7000 ft.—Rocky Ford; Colorado City; Arkansas River; Wray.

2. *Hoffmanseggia drepanocarpa* A. Gray. In dry soil from Colo to Tex.
and Ariz.—Cañon City.

Family 71. FABACEAE Reichenb. PEA FAMILY.

Filaments distinct.

Leaves pinnate.

Leaves digitately 3-foliate.

Filaments monadelphous or diadelphous.

Rachis of the leaves not produced into a tendril or bristle-like appendage, repre-
senting the terminal leaflet.

Fruit 2-valved or indehiscent, not a loment.

Foliage not glandular-dotted.

Anthers of 2 kinds; filaments monadelphous; leaves digitate; calyx 2-
lipped.

Tribe III. GENISTEAE.

Anthers all alike; filaments diadelphous; calyx 5-toothed.

Leaflets toothed.

Tribe IV. TRIFOLIEAE.

Leaflets not toothed.

Leaves irregularly pinnate; leaflets even in number, 4 or 6; stip-
ules gland-like; flowers umbellate.

Tribe V. LOTAEAE.

Leaves odd-pinnate; stipules not gland-like; flowers racemose or
capitate.

Tribe VI. GALEGEAE.

Foliage glandular-dotted.

Pod prickly.

Tribe VII. GLYCRRHIZEAE.

Pod not prickly, indehiscent.

Tribe VIII. PSORALEAE.

- Pod a loment, *i. e.*, breaking up transversely into 1-seeded indehiscent reticulate internodes. Tribe IX. HEDYSAREAE.
 Rachis of the leaves produced into a tendril or bristle-like appendage. Tribe X. VICIEAE.

TRIBE I. SOPHOREAE.

One genus.

1. SOPHORA.

TRIBE II. PODALYRIEAE.

One genus

2. THERMOPSIS.

TRIBE III. GENISTEAE.

One genus

3. LUPINUS.

TRIBE IV. TRIFOLIAE.

Leaves digitate; in ours 3-foliolate.

4. TRIFOLIUM.

Leaves pinnately 3-foliolate.

Pod curved or coiled.

5. MEDICAGO.

Pod straight.

6. MELILOTUS.

TRIBE V. LOTEAE.

One genus.

7. ANISOLOTUS.

TRIBE VI. GALEGEAE.

I. Leaves pinnate or unifoliolate.

- A. Blade of the standard as broad as long, spreading; trees.
 Leaflets with stipels; pod broad, margined on one edge.

8. ROBINIA.

9. PETERIA.

Leaflets without stipels; pod narrow.

- B. Blade of the standard relatively narrow, mostly erect; herbs.

1. Keel (lower petals) not produced into a beak.

- a. Pods 2-celled, with a perfect partition.

Pods fleshy, indehiscent or very tardily dehiscent. 10. GEOPRUMNON.

Pods membranous, leathery or woody, dehiscent.

Pods not inflated.

Pods ovoid or oblong, rarely almost didymous, terete or vertically flattened, leathery or woody. 11. ASTRAGALUS.

Pods linear, somewhat laterally flattened, membranous.

12. HAMOSA.

13. CYSTIUM.

Pods strongly inflated, papery.

- b. Pods 1-celled, the partition, if any, rudimentary.

Lower suture strongly intruded, making the pod sagittate or obcordate in cross-section; pod membranous, rarely leathery.

14. TIUM.

Lower suture not intruded or merely slightly so; pods in the latter case woody.

Pods strongly inflated, papery.

25. PHACA.

Pods not inflated, or slightly so, membranous to woody.

Pods with a partial partition, formed by the inflexion of the lower suture.

Pods membranous.

15. ATELOPHRAGMA.

Pods woody.

Pods stipitate; leaves unifoliolate.

16. JONESIELLA.

Pods sessile; leaves pinnate.

Calyx-tube short, campanulate, equalling or shorter than the lobes; tall glabrous plants.

17. PHACOPSIS.

Calyx cylindrical, longer than the lobes; low caespitose, cinerous or villous plants.

18. XYLOPHACOS.

Pods without a vestige of a partition.

Pods not with two grooves on the upper side (or if slightly grooved, sessile).

Pods with a fleshy epicarp, in fruit cross-ribbed; leaflets obscurely articulated to the rachis, fleshy, narrow.

19. CTENOPHYLLUM.

Pods without fleshy epicarp; leaflets distinctly articulated to the rachis.

Pods woody or at least leathery, flattened or slightly intruded on the lower side.

Calyx cylindrical; flowers large; plant mostly low and caespitose.

18. XYLOPHACOS.

Calyx campanulate; flowers small.

Corolla yellow; calyx-lobes linear-lanceolate, equalling the tube; stipules united; stem low.

20. CNEMIDOPHACOS.

Corolla purple; calyx-lobes triangular; much shorter than the tube; stipules free or nearly so; stem tall and slender.

21. MICROPHACOS.

Pods membranous, usually more or less flattened laterally, with both sutures prominent.

Leaflets spinulose-tipped; pod 1-2-seeded.

23. KENTROPHYTA.

Leaflets not spinulose-tipped; pods several-seeded.

24. HOMALOBUS.

Pods with two grooves on the upper side, stipitate.

22. DIHOLCOS.

2. Keel (lower petals) produced into a beak.

27. ARAGALLUS.

II. Leaves digitately 3-foliolate.

Flowers racemose.

26. OROPHACA.

Flowers capitate (some species of).

4. TRIFOLIUM.

TRIBE VII. GLYCYRRHIZEAE.

One genus.

28. GLYCYRRHIZA.

TRIBE VIII. PSORALEAE.

Petal 1 (standard); leaves odd-pinnate.

29. AMORPHA.

Petals 5.

Wings and keel free from the filament-tube; leaves in our digitate.

30. PSORALEA.

Wings and keel adnate to the filament-tube; leaves odd-pinnate.

Stamens 9 or 10.

31. PAROSELA.

Stamens 5.

32. PETALOSTEMON.

TRIBE IX. HEDYSAREAE.

Pod 4-several-seeded, neither spiny nor toothed.

33. HEDYSARUM.

Pod 1-2-seeded, more or less spiny or toothed.

34. ONOBRYCHIS.

TRIBE X. VICIEAE.

Style filiform, hairy all around and below the apex; stamen-tube usually oblique at the summit.

35. VICIA.

Style flattened towards the apex, hairy on the inner side; stamen-tube usually truncate or nearly so.

36. LATHYRUS.

1. SOPHORA L.

1. *Sophora sericea* Nutt. Dry prairies from S. D. and Wyo. to Tex. and Ariz.—Alt. 4000-7000 ft.—New Windsor, Weld Co.; Colorado Springs; Ft. Collins; mesas near Pueblo; Walsenburg; Poudre Flats; Trinidad; Boulder; Colorado City.

2. **THERMOPSIS** R. Br.

Pods erect or ascending.

Pods straight.

Pods strictly erect and appressed, densely pubescent; stipules narrow.

1. *T. montana*.

Pods ascending-erect, sparingly pubescent; stipules broad.

2. *T. pinetorum*.

3. *T. divaricarpa*.

Pods arcuate, with spreading tips.

4. *T. arenosa*.

Pods strongly divaricate or reflexed, curved.

5. *T. rhombifolia*.

Pods mostly horizontal, arcuate.

Pods reflexed, curved in a half-circle or more.

1. *Thermopsis montana* Nutt. (*T. stricta* Greene) In meadows from Mont. and Wash. to Colo., Utah and Ore.—Alt. 5000-9000 ft.—Hounold; Larimer Co.; Grayback mining camps and Placer Gulch; along Conejos River, north of Antonito; Sapinero; Gunnison.

2. *Thermopsis pinetorum* Greene. In open woodlands and on hillsides in Colo. and N. M.—Alt. 5000-9000 ft.—Chicken Creek, West La Plata Mountains; East Indian Creek; Los Pinos (Bayfield); Grayback mining camps and Placer Gulch; Table Rock; foot of Horsetooth Mountain; Rist Cañon; Boulder; Colorado Springs; Marshall Pass.

3. *Thermopsis divaricarpa* A. Nels. In valleys and on foot-hills in Wyo. and Colo.—Alt. 5000-11,000 ft.—Denver; Cucharas Valley, near La Veta; Veta Mountain; Ute Pass; Sangre de Cristo Creek; mountain near Veta Pass; Ft. Collins; Howe's Gulch; Beaver Creek; Horsetooth Mountain; Cache la Poudre; foot-hills near Boulder; Eldora to Baltimore; Rist Cañon; Anita Peak.

4. *Thermopsis arenosa* A. Nels. In sandy soil from Sask. and Mont. to Colo.—Alt. 8000-10,000 ft.—Empire; Eldora to Baltimore.

5. *Thermopsis rhombifolia* (Nutt.) Richardson. In sandy soil from Sask. and Mont. to Colo.—Alt. 4000-8000 ft.—Manitou; butte five miles southwest of La Veta; mesas near Colorado Springs; Black's Lake; west of Soldier Cañon; north of La Porte; north of Ft. Collins; Trinidad.

3. **LUPINUS** L. LUPINE.

A. Perennials; cotyledons petioled after germination.

I. Stems tall, 3 dm. or more, scarcely caespitose.

1. Leaves glabrous above, at least in age.

Stem pubescent with long and spreading hairs or glabrous.

Banner not with a dark spot; leaflets of the basal leaves oblanceolate, acute.

1. *L. amplus*.

Banner with a dark spot; leaflets of the basal leaves spatulate, obtuse, mucronate.

2. *L. ammophilus*.

Stem appressed-pubescent, at least above.

Flowers large, over 12 mm. long; banner with a dark spot.

3. *L. plattensis*.

Flowers small or middle-sized, 12 mm. or less long; banner not with a dark spot.

Plant green; stem and lower surface of the leaves sparingly appressed-pubescent.

Flowers middle-sized, 8-12 mm. long.

Plant purplish; calyx strongly gibbous at the base.

4. *L. rubricaulis*.

Plant green; calyx not strongly gibbous.

5. *L. alpestris*.

Flowers very small, 6-8 mm. long.

- Flowers about 8 mm. long. 6. *L. parviflorus*.
 Flowers about 6 mm. long. 7. *L. floribundus*.
 Plant vivid green, not at all canescent. 8. *L. myrianthus*.
 Plant dark green; inflorescence and young leaves canescent.
 Plant light green; stem more strigose; leaves more or less silvery;
 flowers light blue or white.
 Flowers about 8 mm. long; leaflets linear. 11. *L. tenellus*.
 Flowers 10-12 mm. long; leaflets oblanceolate. 12. *L. decumbens*.
2. Leaves permanently pubescent above.
 Plant green; leaves appressed-pubescent or slightly silky; pubescence of
 the stem long, spreading. 9. *L. comatus*.
 Plants more or less canescent or silvery; at least the upper part of the stem,
 inflorescence and the lower surface of the leaves densely silky or villous.
 Stem appressed-pubescent.
 Calyx distinctly spurred at the base. 10. *L. argophyllus*.
 Calyx not spurred, but sometimes rather strongly gibbous at the base.
 Flowers less than 12 mm. long; banner not conspicuously light-
 spotted.
 Pubescence of the leaves finely silky, short, not dense, and per-
 fectly appressed.
 Pubescence of the inflorescence finely appressed-silky; leaflets
 oblanceolate. 13. *L. argenteus*.
 Pubescence of the inflorescence looser and spreading. 12. *L. decumbens* var.
 Pubescence of the leaves dense, longer and often looser. 14. *L. oreophilus*.
 Flowers 12 mm. or more long; banner with a large conspicuous light
 spot.
 Stem few-leaved, only slightly exceeding the long basal leaves. 15. *L. humicola*.
 Stem very leafy, many times exceeding the basal leaves. 16. *L. sericeus*.
 Stem with dense pubescence of spreading usually short hairs.
 Corolla blue; banner with a light spot. 17. *L. Bakeri*.
 Corolla at first white; the banner changing into purple; no light spot. 18. *L. dichrous*.
- II. Stem low, less than 3 dm. high, densely caespitose.
 Inflorescence much exceeding the leaves. 19. *L. psoraloides*.
 Inflorescence not exceeding the leaves.
 Racemes very dense and short, sessile; bracts lanceolate, about equalling
 the flowers; pubescence rather appressed. 20. *L. caespitosus*.
 Racemes elongated; bracts subulate, exceeding the flowers; pubescence
 loose. 21. *L. Watsoni*.
- B. Annuals; cotyledons after germination sessile, clasping the stem; pod 2-seeded.
 Raceme dense, subcapitate; lower lip of the calyx 2-3-toothed.
 Plant almost stemless; lower lip of the calyx oval or ovate. 22. *L. brevicaulis*.
 Plant with a distinct leafy stem; lower lip of the calyx oblong-lanceolate. 23. *L. Kingii*.
 Racemes more elongated and less dense; lower lip of the calyx entire. 24. *L. pusillus*.

1. *Lupinus amplus* Greene. In the mountains of Colo.—Alt. about 8000 ft.—Cerro Summit; below Steamboat Springs.

2. *Lupinus ammophilus* Greene. (*L. Sitgreavesii* Coult. Man., in part.) In the mountains of Colo. and N. M.—Alt. 6000-7000 ft.—Los Pinos (Bay-field); Mancos; Durango.

3. *Lupinus plattensis* S. Wats. On hillsides in western Neb., Wyo. and Colo.—Alt. 5000-8000 ft.—Walsenburg; Denver; La Veta; butte five miles southwest of La Veta.

4. *Lupinus rubricaulis* Greene. Hills in Colo.—Alt. about 9000 ft.—Custer Butte.

5. *Lupinus alpestris* A. Nels. (*L. alsophilus* Greene.) In mountain valleys from Mont. to Colo. and Utah.—Alt. 8000-11,000 ft.—North fork of Cache la Poudre; divide above Steamboat Springs; Grizzly Creek; Little Veta Mountain; Four-Mile Hill; North Park; Buffalo Pass; mountains above Ouray; summit of North Park Range, Routt Co.

6. *Lupinus parviflorus* Nutt. In open woods, on hillsides, among bushes, S. D. and Mont. to Colo. and Utah.—Alt. 8000-12,000 ft.—Near Empire; Red Mountain road, south of Ouray; Pearl; North Park, near Teller; Berthoud Pass; Breckenridge.

7. *Lupinus floribundus* Greene. In the mountains of Colo.—Upper Bear Creek.

8. *Lupinus myrianthus* Greene. In the mountains of Colo.—Alt. 8000-9000 ft.—Pitkin; Parlin, Gunnison Co.; Jack's Cabin.

9. *Lupinus comatus* Rydb. In the mountains of Colo.—Alt. about 8000 ft.—Lake City; Chicken Creek, La Plata Mountains; Gunnison Co.

10. *Lupinus argophyllus* (A. Gray) Cockerell. (*L. decumbens argophyllus* A. Gray; *L. Helli* Greene; *L. aduncus* Greene) Valleys and river banks from Neb. and Colo. to N. M.—Alt. 4000-9000 ft.—Durango; Sangre de Cristo Creek; Grayback mining camps and Placer Gulch; Mancos; Mesa Verde; Colorado Springs; Antonito; bank of Conejos River.

11. *Lupinus tenellus* Nutt. In the mountains from Mont. to Colo. and Calif.—Estes Park; Mt. Harvard; Middle Park; Twin Lakes; Kremmling.

12. *Lupinus decumbens* Torr. (*L. argenteus decumbens* A. Gray; *L. leptostachys* Greene) On prairies and hillsides from Neb., Mont. and Ore. to Colo. and Calif.—Alt. 4000-9000 ft.—Boulder; Douglass Co.; foot-hills, Larimer Co.; Colorado Springs; Wahatoya Creek; La Veta; Mosquito Pass; Moon's ranch; Victoria; Veta Mountain; North Park; Trail Creek; Rist Cañon; Sapinero; New Windsor; Bosworth's ranch; Pennock's mountain ranch; Horsetooth Mountain; Callaway; Redcliffe.

Lupinus decumbens argentatus Rydb. Leaflets broader than in the type and not conduplicate. On prairies and hillsides in Wyo. and Colo.—Alt. 5000-9000 ft.—High mountains, Larimer Co.; between Sunshine and Ward; foot-hills near Boulder.

13. *Lupinus argenteus* Pursh. On prairies from Mont. to Colo.—Glenwood Springs.

14. *Lupinus oreophilus* Greene. In the mountains from Wyo. to Utah and Colo.—West Cliff; Cimarron; Steamboat Springs; Meeker; Rio Blanco Co.

15. *Lupinus humicola* A. Nels. In rich soil in Colo. and Wyo.—Near Ironton, San Juan Co.

16. *Lupinus sericeus* Pursh. On prairies from Ass. and Wash. to Wyo. and Nev. A doubtful specimen has been collected in Colo.—Minturn.

17. *Lupinus Bakeri* Greene. In the mountains of Colo.—Alt. 7000-8500 ft.—Hesperus; Los Pinos (Bayfield); Cedar Edge.

18. *Lupinus dichrous* Greene. In the mountains of Colo.—Alt. about 7000 ft.—Cedar Edge.

19. *Lupinus psoraloides* Pollard. Open gravelly soil in Colo.—Gunnison.

20. *Lupinus caespitosus* Nutt. On hillsides from Mont. to Colo. and Utah.—Alt. about 8000 ft.—Hinsdale Co.; North Park, near Teller; twelve miles below Grand Lake; Gunnison; Kremmling.

21. *Lupinus Watsoni* Heller. (*Lupinus aridus Utahensis* S. Wats.) In sandy soil from Ida. to Colo. and Utah.—North Park; Gunnison.

22. *Lupinus brevicaulis* S. Wats. On hills from Colo. and Utah to N. M. and Ariz.—Alt. 5000-6000 ft.—Arboles; Hotchkiss, Delta Co.

23. *Lupinus Kingii* S. Wats. (*L. Sileri* S. Wats.) In dry soil from Utah and Colo. to Ariz.—Alt. 4000-8000 ft.—Mancos; Garland; Piedra; Thompson's Park, La Plata Mountains; Gunnison.

24. *Lupinus pusillus* Pursh. On dry plains from Mont. and Ore. to Kans., N. M. and Utah.—Alt. 1500-1600 m.—Mesas near Pueblo; New Windsor; Crow Creek; La Porte, Larimer Co.; Wray; Hotchkiss; Lamar; Rocky Ford; Ft. Collins; Walsenburg.

4. TRIFOLIUM L. CLOVER.

Heads not involucrate.

Plants mostly tall; stem leafy.

Calyx hairy.

Heads sessile; corolla red-purple; free portion of the stipules ovate.

1. *T. pratense*.

Heads long-peduncled; corolla white or pink; free portion of the stipules elongated-lanceolate.

Plants caespitose from a woody root; stems ascending; corolla salmon-color.

2. *T. Rusbyi*.

Plant erect from a creeping rootstock; corolla white.

3. *T. Rydbergii*.

Calyx glabrous; peduncles axillary; corolla white or rose-color.

4. *T. repens*.

Plants low, caespitose; stems scapiform.

Calyx glabrous.

Heads 1-3-flowered; flowers not reflexed; calyx-teeth lanceolate; caudex thick, densely caespitose with short branches.

5. *T. nanum*.

Heads several-flowered; flowers reflexed; calyx-teeth subulate; branches of the caudex more slender and elongated.

6. *T. Brandegei*.

Calyx pubescent.

Leaflets oval or obovate, strongly veined and sharply dentate.

Flowers 10-12 mm. long.

7. *T. subacaulescens*.

Flowers about 8 mm. long.

8. *T. gymnocarpon*.

Leaflets lanceolate or linear-lanceolate, entire and not strongly veined.

Flowers reflexed in fruit; bracts minute, truncate and toothed.

Calyx $\frac{3}{4}$ - $\frac{1}{2}$ as long as the corolla; its teeth fully twice as long as the tube.

9. *T. stenolobum*.

Calyx about half as long as the corolla; its teeth only slightly longer than the tube.

Banner acuminate; leaflets linear-lanceolate.

10. *T. attenuatum*.

Banner obtuse, minutely mucronate; leaflets oblong-lanceolate to elliptic.

11. *T. bracteolatum*.

Flowers not reflexed in fruit; bracts more conspicuous, lanceolate to subulate, long-attenuate.

Bracts narrowly linear-lanceolate or subulate, much exceeding the calyx-tube and often almost equalling the calyx-teeth; plant bright green.

12. *T. lividum*.

Bracts slightly, if at all, exceeding the calyx-tube, distinctly scarious-margined and abruptly contracted into a long acumination; plant grayish.

13. *T. dasyphyllum*.

Heads more or less involucrate by more or less united bracts.

Plants low, caespitose; stem scapiform; bracts united only at the base.

Bracts lanceolate to linear-subulate; leaflets entire (see No. 9-13).

Bracts oblong, oval, ovate or obovate; leaflets dentate.

Banner long-acute, much exceeding the wings.

14. *T. salictorum*.

Banner blunt, slightly exceeding the wings.

15. *T. Parryi*.

Plants with elongated leafy stem; bracts united to a monophyllous involucre.

Corolla 12-15 mm. long.

16. *T. Fendleri*.

Corolla about 10 mm. long.

17. *T. oxydon*.

1. *Trifolium pratensis* L. Cultivated and escaped along roads, around dwellings and in waste places from Newf. and B. C. to Colo. and Calif.—Ft. Collins.

2. *Trifolium Rusbyi* Greene. In meadows from Colo. to Ariz. and Calif.—Mancos.

3. *Trifolium Rydbergii* Greene. (*T. longipes* A. Gray and Coult., in part; not Nutt.) In meadows from Mont. and Ida. to Colo. and Utah.—Alt. 6000-10,000 ft.—Chicken Creek, West La Plata Mountains; mountain near Veta Pass; Pearl; Elk River, Routt Co.; West Indian Creek; Gore Pass; Dolores; Holdredge's ranch, North Park; Camp Creek.

4. *Trifolium repens* L. Cultivated and escaped in waste places and meadows from Newf. to B. C. to Fla. and Calif.—Alt. up to 7000 ft.—Cucharas Valley, near La Veta.

5. *Trifolium nanum* Torr. In the mountains from Mont. to Colo.—Alt. 9000-14,000 ft.—Mt. Evans; Lake City; Pike's Peak; near Empire; Carson; Gray's Peak; mountains above Como; West Spanish Peak; Hayden Peak; near Pagosa Peak; Cameron Pass; Berthoud Pass.

6. *Trifolium Brandegei* S. Wats. In the mountains of Colo.—Alt. up to 12,500 ft.—Near Pagosa Peak; Cumberland Basin, La Plata Mountains.

7. *Trifolium subcaulescens* A. Gray. (*T. nemorale* Greene) In dry soil in Colo. and N. M.—Los Pinos; Glenwood Springs; Mancos.

8. *Trifolium gymnocarpon* Nutt. In arid places from Wyo. to Colo. and Utah.—Alt. up to 8000 ft.—North Park; Cerro Summit.

9. *Trifolium stenolobum* Rydb. On alpine peaks of Colo.—Alt. 9000-12,000 ft.—Little Kate Basin, La Plata Mountains; Upper La Plata Cañon; near Ironton, San Juan Co.

10. *Trifolium attenuatum* Greene. On alpine peaks of Colo.—Alt. about 11,500 ft.—Near Pagosa Peak.

11. *Trifolium bacteolatum* Rydb. (*T. lilacinum* Rydb.; not Greene; *S. petraeum* Greene) On mountain peaks of southern Colo.—Alt. 9000-10,000 ft.—West Spanish Peak.

12. *Trifolium lividum* Rydb. On alpine peaks of Wyo. and Colo.—Alt. 10,000-12,000 ft.—Massif de l'Arapahoe; Graymont; Alpine Tunnel.

13. *Trifolium dasyphyllum* Torr. On alpine peaks from Mont. to Colo.—Alt. 7000-13,000 ft.—Berthoud Pass; Eldora to Baltimore; Lake City; Pike's Peak; Hinsdale Co.; headwaters of Clear Creek; Cameron Pass; Bald Mountain; Mt. Harvard; Silver Plume; mountains above Boreas; Twin Lakes; mountains of Larimer Co.; Flat Top Mountains, Routt Co.;

mountains south of Ward, Boulder Co.; Devil's Causeway; above Beaver Creek; Leroux Creek; Twin Lakes; Spicer.

14. *Trifolium salictorum* Greene. Mountains of Colo.—Alt. about 12,000 ft.—Carson.

15. *Trifolium Parryi* A. Gray. In the mountains of Wyo., Utah and Colo.—Alt. 10,000–13,000 ft.—Twin Lakes; headwaters of Clear Creek; Tennessee Pass, seven miles west of Leadville; Cameron Pass; Buena Vista, Chaffee Co.; Marshall Pass; mountains above Boreas; Estes Park; Silver Plume; Gray's Peak; Robinson; Chambers' Lake; Graymont; Leroux Creek; above Beaver Creek; Berthoud Pass.

16. *Trifolium Fendleri* Greene. In meadows from Colo. to N. M. and Ariz.; also in Mex.—Alt. up to 8000 ft.—Wahatoya Creek; Gunnison; La Veta; Parlin, Gunnison Co.; Buena Vista; along the Conejos River, north of Antonito; Monte Vista.

17. *Trifolium oxyodon* Greene. In meadows from Colo. to Ariz.—Alt. up to 7700 ft.—Gunnison.

5. *MEDICAGO* L. ALFALFA, LUCERNE, MEDIC.

1. *Medicago sativa* L. Cultivated from Europe and escaped from Me. and Ida. to Va. and Utah.—Alt. 5000–6000 ft.—Colorado Springs; Ft. Collins; Boulder.

6. *MELILOTUS* Juss. SWEET CLOVER

Corolla white; banner a little longer than the wings.

1. *M. alba*.

Corolla yellow; banner about equalling the wings.

2. *M. officinalis*.

1. *Melilotus alba* Desv. In waste places from N. S. and D. C. to Ida. and Nev. Naturalized from Europe; also cultivated.—Alt. 4000–7000 ft.—Cucharas Valley, near La Veta.

2. *Melilotus officinalis* (L.) Lam. In waste places from N. S. and La. to Ida. and Colo. Naturalized from Europe; occasionally cultivated for bees.—Alt. 4000–6000 ft.—Ft. Collins; Boulder.

7. *ANISOLOTUS* Bernh. BIRD'S-FOOT TREEFOIL

1. *Anisototus Wrightii* (A. Gray) Rydb. (*Hosackia Wrightii* A. Gray) In dry soil from Colo. to N. M. and Ariz.—Alt. 7000–8000 ft.—Dolores; Mancos.

8. *ROBINIA* L. LOCUST-TREE

1. *Robinia neo-mexicana* A. Gray. Along streams from Colo. to N. M. and Ariz.—Alt. 4000–7000 ft.—Trinidad; Walsenburg; La Veta; Denver.

9. *PETERIA* A. Gray.

1. *Peteria scoparia* A. Gray. Dry regions from Colo. and Utah to N. M. and Ariz.—La Plata Valley (*Brandegee*).

10. *GEOPRUMNON* Rydb. BUFFALO BEANS, GROUND PLUMS.

Corolla yellowish white, with purple-keel; leaflets oval or obovate.

1. *G. succulentum*.

Corolla purple; leaflets oblong to linear.

2. *G. crassicaepum*.

1. *Geoprumnon succulentum* (Richardson) Rydb. (*Astragalus succulentus* Richardson; *A. prunifer* Rydb.) On plains and hills from Sask. and Mont. to S. D. and Colo.—Alt. 4000–7000 ft.—Ft. Collins; foot-hills, Larimer Co.; Colorado Springs; Cucharas River, below La Veta; Walsenburg; bank of Cache la Poudre; Horsetooth Gulch; Velmont.

2. *Geoprumnon crassicaarpus* (Nutt.) Rydb. (*Astragalus crassicaarpus* Nutt.; *A. caryocarpus* Ker) On prairies and plains from Man. and Mont. to Mo. and Tex.—Alt. 4000–5000 ft.—Plains near Denver; South Park; Lamar; Ft. Collins; Howe's Gulch.

11. ASTRAGALUS L. LOCO WEEED, MILK VETCH.

Plants caespitose, subscapose, villous-pubescent; pods sulcate on both sutures.

Pod glabrous, deeply sulcate.

1. *A. mollissimus*.

Pod villous, slightly sulcate.

Calyx densely villous; leaflets 6–12 pairs.

2. *A. Bigelovii*.

Calyx sparingly nigrescent; leaflets 3–6 pairs.

3. *A. anisus*.

Plants with elongated leafy stems.

Pods not sulcate or slightly so on the lower suture, round or nearly so in cross-section.

Bracts linear-lanceolate, long-attenuate; the lower almost as long as the calyces; calyx-teeth all narrow, subulate, fully half as long as the tube; pod glabrous.

4. *A. canadensis*.

Bracts ovate to lanceolate, scarcely half as long as the calyces; calyx-teeth short, less than half as long as the tube; the upper broader; pod more or less hairy.

5. *A. oreophilus*.

Pod deeply sulcate on the lower suture, cordate or triangular in cross-section.

Pod with appressed gray or black pubescence.

Corolla purple or pink, seldom white; calyx-teeth much shorter than the tube.

6. *A. nitidus*.

Corolla sulphur-yellow; calyx-teeth almost equalling the tube.

7. *A. sulphurescens*.

Pod villous with long spreading hairs.

Corolla ochroleucous; bracts broadly spatulate, very obtuse.

8. *A. virgultatus*.

Corolla purple; bracts ovate-lanceolate or oblong, often acutish.

9. *A. goniatus*.

1. *Astragalus mollissimus* Torr. On prairies from Neb. and Wyo. to Tex. and N. M.—Alt. 4000–5000 ft.—Ft. Collins; Lamar.

2. *Astragalus Bigelovii* A. Gray. In dry soil from Colo. to Tex. and Ariz.; also in Mex.—Alt. 4000–5000 ft.—Grand Junction.

3. *Astragalus anisus* Jones. On dry mesas of Colo.—Pueblo.

4. *Astragalus canadensis* L. Among bushes and in meadows from Que. and B. C. to Fla. and Calif.—Alt. 4000–5000 ft.—La Veta; Roswell; Lower Boulder Cañon, Boulder Co.; Ft. Collins; Poudre flats; between Ft. Collins and La Porte; gulch west of Soldier Cañon; along Conejos River.

5. *Astragalus oreophilus* Rydb. (*A. Mortonii* Coulter, in part; not Nutt.) Among bushes in Colo.—Alt. 5000–8000 ft.—Pagosa Springs; mountains, Larimer Co.; Wahatoya Creek; Trimble Springs, above Durango; Stove Prairie, Larimer Co.; plains and foot-hills near Boulder; Walsenburg.

6. *Astragalus nitidus* Dougl. (*A. adsurgens* Hook., and Am. auth.; not Pall.) On hills and plains from Minn., Sask. and Alb. to Colo. and Oregon.—Alt. 4000–11,000 ft.—South Park; Manitou Springs; Platte River; Chey-

enne Cañon; Walsenburg; Little Veta Mountain; Colorado Springs; Mt. Harvard; west of Soldier Cañon; La Porte; Como; Redcliffe.

7. *Astragalus sulphureus* Rydb. On hills and mountains of Colo.—Alt. 5000–10,000 ft.—Boulder Cañon; Georgetown; Platte River, Denver; Estes Park; vicinity of Como; Long Gulch; near Boulder; Empire.

8. *Astragalus virgultatus* Sheld. (*A. hypoglottis bracteosus* Osterh.) In mountain meadows of Colo. and Wyo.—Alt. 5000–8000 ft.—Boulder; Gunnison.

9. *Astragalus goniatus* Nutt. (*A. hypoglottis polyspermus* T. & G.; *A. hypoglottis* Richardson; not L.) In meadows and river valleys from Sask. and Wash. to Colo. and Calif.—Alt. 4000–9000 ft.—Boulder; Valmont; Alamosa; Parlin, Gunnison Co.; Cimarron; Salida; butte five miles southwest of La Veta; Ft. Collins; Dillon; Buena Vista; Arboles; Cucharas River, below La Veta; Pagosa Springs; Stove Prairie, Larimer Co.; near La Plata Post Office; Sangre de Cristo Creek; Table Rock; Horsetooth Gulch; Dolores; Como; Colorado City.

12. HAMOSA Medic.

Plant acaulescent, silvery-white.

Plant caulescent, not silvery.

Pods curved.

Pods straight.

1. *A. scaposa*.

2. *H. Nuttalliana*.

3. *H. leptocarpa*.

1. *Hamosa scaposa* (A. Gray) Rydb. (*Astragalus scaposus* A. Gray.) On dry hills from Wyo. to N. M. and Ariz.—McElmo Cañon.

2. *Hamosa Nuttalliana* (DC.) Rydb. (*A. Nuttallianus* DC.) In dry soil from Colo. and Ark. to Tex. and N. M.—Alt. 4000–5000 ft.—Palisades.

3. *Hamosa leptocarpa* (T. & G.) Rydb. (*A. leptocarpus* T. & G.) In dry soil from Tex. to Colo.—Lake City.

13. CYSTIUM Stev.

1. *Cystium diphysum* (A. Gray) Rydb. (*Astragalus diphyus* A. Gray) On hills from Colo. and Utah to N. M. and Ariz.—“Southwestern Colorado” (Brandegge); exact locality not given.

14. TIUM Medic.

Stipe equalling or exceeding the calyx; pod not incurved.

Pods not black-hairy; corolla white or ochroleucous.

Plant villous; pod cordate in cross-section.

Plant appressed-pubescent or glabrous; pod more or less triangular or inverted V-shaped in cross-section.

Calyx not black-hairy; pod straight.

Calyx black-hairy; pod arcuate.

Pod black-hairy; corolla purple.

Stipe shorter than the calyx or almost none; pod incurved.

Pod mottled; plant green.

Pod not mottled; plant cinereous.

Pod appressed-pubescent.

Pod hirsute-villous with spreading hairs.

1. *T. Drummondii*.

2. *T. racemosum*.

3. *T. scopulorum*.

4. *T. alpinum*.

5. *T. sparsiflorum*.

6. *T. humistratum*.

7. *T. desperatum*.

1. *Tium Drummondii* (Dougl.) Rydb. (*Astragalus Drummondii* Dougl.) On hills, plains and valleys from Sask. and Alb. to Neb. and Colo.—Alt. 4000–8000 ft.—Southeast of La Veta; Cimarron; La Veta; Cheyenne Cañon; Ft. Collins; Colorado Springs; Horsetooth Gulch; east of Soldier Cañon; Boulder.

2. *Tium racemosum* (Pursh) Rydb. (*Astragalus racemosus* Pursh.) On plains and hills, N. D. to Kans. and N. M.—Oak Creek; Apishipa Creek, Otero Co.; east of Soldier Cañon.

3. *Tium scopulorum* (Porter) Rydb. (*Astragalus scopulorum* Porter; *A. rarus* Sheldon) On hills and open woods in the mountains of Colo.—Alt. 5000–9000 ft.—Grand Junction; Mancos; Grayback mining camps and Placer Gulch; Los Pinos; Cerro Summit; Cimarron; Dolores.

4. *Tium alpinum* (L.) Rydb. (*Astragalus alpinus* L.) In the mountains and in open woodlands from Lab. and Alaska to Vt. and Colo.—Alt. 6000–11,000 ft.—Lake City; Boulder Cañon; near Empire; Carson; Twin Lakes; Veta Pass; North Park; Twin Lake Creek; near La Plata Post Office; Mt. Harvard; headwaters of Sangre de Cristo Creek; Como, South Park; Piedra; North Park, near Teller; Leroux Park; Michigan River; Chambers' Lake; Graymont.

5. *Tium sparsiflorum* (A. Gray) Rydb. (*Astragalus sparsiflorus* A. Gray) In the mountains of Colo.—Alt. about 8000 ft.—Cascade Cañon.

6. *Tium huministratum* (A. Gray) Rydb. (*Astragalus huministratus* A. Gray) In the mountains from Colo. and Utah to N. M. and Ariz.—Alt. about 7000 ft.—Los Pinos.

7. *Tium desperatum* (Jones) Rydb. (*Astragalus desperatus* Jones) In the mountains of Colo. and Utah.—Grand Cañon.

15. ATELOPHRAGMA Rydb.

Pods stipitate, flat.

Pod long-stipitate, glabrous, at least in age.

Pod short-stipitate, hairy.

Pod sessile, more turgid.

Racemes many-flowered; leaflets oblong; septum narrow.

Racemes elongated; pod short obovate.

Racemes short; pod oblong.

Racemes few-flowered; leaflets linear; septum broad.

1. *A. aboriginum*.

2. *A. Macounii*.

3. *A. elegans*.

4. *A. Shearis*.

5. *A. Brandegei*.

1. *Atelophragma aboriginum* (Richardson) Rydb. (*Phaca aboriginum* Richardson) On mountain sides and in open woods from Alb. and Yukon to Colo. and Nev.—Alt. up to 10,000 ft.—Mountain near Veta Pass.

2. *Atelophragma Macounii* Rydb. (*Astragalus Macouni* Rydb.) In the mountains from Alb. and B. C. to Colo.—Exact locality not given.

3. *Atelophragma elegans* (Hook.) Rydb. (*Phaca elegans* Hook.; *Astragalus oroboides americanus* A. Gray) In the mountains from Que., Sask. and Idaho to Colo.—Alt. 7000–13,000 ft.—Georgetown; Mt. Lincoln; Lake City; headwaters of Clear Creek; near Empire; South Park; Mancos; North Park; Empire.

4. *Atelophragma Shearis* Rydb. In the mountains of Colo.—Twin Lakes.

5. *Atelophragma Brandegei* (Porter) Rydb. (*Astragalus Brandegei* Porter) In the mountains from Colo. and Utah to Ariz.—Alt. about 6500 ft.—Arkansas River bluffs; Pleasant Valley.

16. JONESIELLA Rydb.

1. *Jonesiella asclepiadoides* (Jones) Rydb. (*Astragalus asclepiadoides* Jones) In arid soil of Colo. and Utah.—Southeast of Hotchkiss; Grand Junction.

17. PHACOPSIS Rydb.

Plant perfectly glabrous; leaflets oval, retuse or obtuse.

1. *P. praelongus*.

Plant hispidulous-strigose on the upper part of the stem and the lower surface of the leaves.

2. *P. Pattersonii*.

1. *Phacopsis praelongus* (Sheldon) Rydb. (*A. procerus* A. Gray) From Colo. to N. M. and Ariz.—Alt. 2500-6500 ft.—Arboles; Cimarron.

2. *Phacopsis Pattersonii* (A. Gray) Rydb. (*A. Pattersonii* A. Gray) On plains and open ground in Colo. and Utah.—Alt. up to 7000 ft.—Mancos; Wolcott, Eagle Co.; Grand River Cañon; Hotchkiss; Grand Junction; Ridgeway.

18. XYLOPHACOS Rydb.

Pod short-hairy or glabrous.

Plant villous; both of the sutures inflexed.

1. *X. Parryi*.

Plant cinereous; none of the sutures or only the dorsal one inflexed.

Pod at first somewhat fleshy, in age spongy; plant acaulescent.

2. *X. pygmaeus*.

Pod coriaceous.

Pods straight or nearly so.

Pods when mature somewhat compressed laterally.

3. *X. missouriensis*.

Pods when mature compressed vertically.

4. *X. vespertinus*.

Pods more or less curved.

Pods obtuse at the base; dorsal suture strongly inflexed; leaves white-silky on both sides.

5. *X. Shortianus*.

Pods tapering at both ends.

Pod over 3 cm. long; upper suture strongly arched; calyx-teeth short, triangular.

6. *X. amphioxus*.

Pod less than 3 cm. long; upper suture straight or slightly curved; calyx-teeth linear-subulate.

7. *X. uinensis*.

Pod long-hairy, densely villous; corolla yellow or keel purple.

Leaflets broadly obovate, appressed-silky.

8. *X. Newberryi*.

Leaflets elliptic or oblanceolate, long-villous.

9. *X. Purshii*.

1. *Xylophacos Parryi* (A. Gray) Rydb. (*Astragalus Parryi* A. Gray) On mountain ridges of Wyo. and Colo.—Alt. 5000-10,000 ft.—Near Empire; Turkey Creek and tributaries; Ft. Collins; Wahatoya Cañon; headwaters of Sangre de Cristo Creek; headwaters of Pass Creek; Estes Park; Bijou Basin; Platte Cañon; Rist Cañon; Chambers' Lake; vicinity of Como; near Boulder.

2. *Xylophacos pygmaeus* (Nutt.) Rydb. (*Phaca pygmaea* Nutt.; *A. chamaeluce* A. Gray; *A. Cicadae* Jones) Dry hills and arid plains of Colo., Wyo. and Utah.—Grand Junction.

3. *Xylophacos missouriensis* (Nutt.) Rydb. (*A. Missouriensis* Nutt.) On plains from Sask. and Mont. to Kans. and N. M.—Alt. 4000-10,000 ft.—Ft. Collins; New Windsor, Weld Co.; Arboles; Walsenburg; river bluffs north of La Veta; mesas near Pueblo; Turkey Creek and tributaries; Grand Junction.

4. *Xylophacos vespertinus* (Sheld.) Rydb. (*A. vespertinus* Sheld.) In arid places of W. Colo. and N. Mex.—Grand Junction.

5. *Xylophacos Shortianus* (Nutt.) Rydb. (*A. Shortianus* Nutt.) On plains and dry hills from western Neb. and Wyo. to Colo. and Ariz.—Alt. 4000-9000 ft.—Ute Pass; plains near Denver; Clear Creek Cañon; Ft. Collins; Rist Cañon; Spring Cañon; west of Dixon Cañon; Hotchkiss; Table Rock; Soldier Cañon; vicinity of Horsetooth; Grand Junction; north of La Porte; near Boulder; Sapinero; Arboles.

6. *Xylophacos amphioxus* (A. Gray) Rydb. (*A. amphioxus* A. Gray) On dry plains and hills from southwestern Colo. to Utah and Ariz.—Exact locality not given.

7. *Xylophacos uintensis* (Jones) Rydb. (*Astragalus Uintensis* Jones) On dry mesas from Colo. to Utah and Ariz.—Alt. 4000-7000 ft.—Mancos; mesas near Pueblo; Cimarron; Grand Junction.

8. *Xylophacos Newberryi* A. Gray. Dry hills from southwestern Colo. and Utah to N. M. and Ariz.—Exact locality not given.

9. *Xylophacos Purshii* Dougl. On plains and hills from Mont. and B. C. to northern Colo. and Calif.—Along North Platte.

19. CTENOPHYLLUM Rydb.

1. *Ctenophyllum pectinatum* (Hook.) Rydb. (*Phaca pectinata* Hook.; *Astragalus pectinatus* Dougl.) On dry plains from Alb. and Sask. to Kans. and Colo.—Ft. Collins.

20. CNEMIDOPHACOS Rydb.

1. *Cnemidophacos flavus* (Nutt.) Rydb. (*Astragalus flavus* Nutt.) On dry mesas from Wyo. to N. M.—Alt. about 6000 ft.—Grand Junction; Mancos; Arboles.

21. MICROPHACOS Rydb.

1. *Microphacos microlobus* (A. Gray) Rydb. (*Astragalus microlobus* A. Gray) On plains and hills from S. D. and Mont. to Kans. and Colo.—Alt. 4000-7000 ft.—Ft. Collins; Walsenburg; New Windsor; mesas near Pueblo; Cucharas Valley, near La Veta; Denver; Colorado City.

22. DIHOLCOS Rydb.

Corolla over 1 cm. long; calyx-teeth nearly as long as the tube.

Corolla purplish or pinkish; pod strigose.

Corolla whitish; pod glabrous.

Corolla whitish or straw color, less than 1 cm. long; calyx-teeth much shorter than the tube.

1. *D. bisulcatus*.

2. *D. decalvans*.

3. *D. Haydenianus*.

1. *Diholcos bisulcatus* (Hook.) Rydb. (*Phaca bisulcata* Hook.; *Astragalus bisulcatus* A. Gray) On plains and in river valleys from Sask. and Mont. to Neb. and Colo.—Alt. 4000-8000 ft.—Pueblo; between La Veta and Gardner; Ft. Collins; mesas near Pueblo; Lamar; Spring Cañon; Platte River; Colorado Springs.

2. *Diholcos decalvans* (Gandoger) Rydb. (*A. bisulcatus decalvans* Gandoger) River valleys of Colo.—Alt. about 5000 ft.—New Windsor, Weld Co.; Ft. Collins; Dixon Cañon; Quimby.

3. *Diholcos Haydenianus* (A. Gray) Rydb. (*A. Haydenianus* A. Gray) In the mountains of Wyo. and Colo.—Alt. about 7000 ft.—Rio Blanco, south of Pagosa; Mancos; Pagosa Springs; Montrose; La Veta; Gunnison; Ridgeway.

23. KENTROPHYTA Nutt.

Stipules united only at the base, more or less herbaceous.

Plants 3-4 dm. high, usually erect; stipules with long spinulose tips.

Plant low; stipules not spinulose-tipped.

2. *K. impensa*.

3. *K. viridis*.

Stipules united for about half their length, scarious.

Corolla ochroleucous, about 4 mm. long; leaflets less than 5 mm. long.

4. *K. Wolfii*.

Corolla purple, about 6 mm. long; leaflets over 5 mm. long.

5. *K. aculeata*.

1. *Kentrophyta impenae* (Sheldon) Rydb. (*Astragalus viridis impensus* Sheldon; *A. Kentrophyta elatus* S. Wats.) In cañons and bad-lands from Colo. to Nev. and Ariz.—Grand River Cañon.

2. *Kentrophyta viridis* Nutt. (*Astragalus Kentrophyta* A. Gray, in part.) In cañons and bad-lands of Wyo. and Colo.—Palisades.

3. *Kentrophyta Wolfii* Rydb. (*Homalobus Wolfii* Rydb.) On dry hills of Colo.—South Park.

4. *Kentrophyta aculeata* (A. Nels.) Rydb. (*A. tegetarius implexus* Canby; *A. aculeatus* A. Nels.) On dry hills and mountains from Mont. to Colo. and Utah.—Alt. 8000-10,000 ft.—Chambers' Lake; Georgetown.

24. HOMALOBUS Nutt.

Leaves simple or some rarely pinnately 3-foliolate; plants pulvinate-cespitose.

SIMPLICIFOLII.

Leaves pinnately 5-many-foliolate.

Pods sessile or short-stipitate; stipe seldom exceeding the calyx.

Pods more or less compressed.

Pods oval, ovate, broadly oblong or elliptical

TENELLI.

Pods linear, 1.5 cm. or more long.

CAMPESTRES.

Pods terete or nearly so.

FLEXUOSI.

Pods long-stipitate; stipe many times as long as the calyx.

MACROCARPI.

SIMPLICIFOLII.

One species.

TENELLI.

1. *H. caespitosus*.

Pods strictly sessile.

Pods erect on long pedicels.

2. *A. grallator*.

Pods spreading or reflexed on short pedicels.

Pods glabrous; plant canescent.

3. *H. Wingatanus*.

Pods hairy; plant green.

4. *H. Clementis*.

Pods short-stipitate.

Leaflets broadly linear or oblong; corolla ochroleucous.

5. *H. tenellus*.

Leaflets narrowly linear; corolla whitish, tinged with purple.

6. *H. acerbus*.

CAMPESTRES.

Calyx-teeth lanceolate to subulate, half as long as the tube or longer.

Pods arcuate.

7. *H. decumbens*.

Pods straight.

Leaflets linear or linear-oblong, acute, ascending.

Leaflets narrowly linear, silvery-canescens.

Low and very caespitose, 1-2 dm. high; pods about 1.5 cm. long; keel with a very narrow end. 8. *H. camporum*.

Tall, 3-4 dm. high, more simple; pods 2-2.5 cm. long; keel with a broader end. 9. *H. campestris*.

Leaflets oblong or lanceolate, strigose but not canescent; terminal leaflet longer, tapering into the rachis without a distinct articulation; racemes long and lax. 10. *H. decurrens*.

Leaflets, at least of the lower leaves, oval or elliptical, spreading. 11. *H. hylophilus*.

Calyx-teeth triangular, $\frac{1}{4}$ - $\frac{1}{2}$ as long as the tube; leaflets linear.

Low, depressed; pods 12-15 mm. long, sessile. 12. *H. tenuifolius*.

Taller, 2 dm. or more high; pods over 15 mm. long, often slightly stipitate. 13. *H. junciformis*.

FLEXUOSI.

Pod oblong, over 5 mm. in diameter.

Inflorescence short; flowers about 15 mm. long; pod glabrous. 14. *H. Hallii*.

Inflorescence elongated and lax; flowers about 10 mm. long; pod pubescent. 15. *H. Fendleri*.

Pod linear, 2-3 mm. thick.

Pod abruptly contracted into a short or obsolete stipe.

Stem decumbent; stipe minute or obsolete. 16. *H. flexuosus*.

Stem erect; stipe almost equalling the calyx. 17. *H. proximus*.

Pod gradually tapering into the short stipe. 18. *H. Salidae*.

MACROCARPI.

One species.

19. *H. macrocarpus*

1. *Homalobus caespitosus* Nutt. (*Astragalus caespitosus* A. Gray.) On dry hills from Ass. and Mont. to Colo. and Utah.—Alt. 4000-6000 ft.—Livermore, Larimer Co.; north of La Porte.

2. *Homalobus grallator* (S. Wats.) Rydb. (*A. grallator* S. Wats.) On river banks from Colo. to Nev.—Steamboat Springs.

3. *Homalobus wingatanus* (S. Wats.) Rydb. (*A. Wingatanus* S. Wats.) On dry hills in S. Colo. and N. Mex.—Mancos.

4. *Homalobus Clementis* Rydb. In the mountains of Colo.—Alt. up to 10,000 ft.—Marshall Pass; Sangre de Cristo; Big Creek Gulch.

5. *Homalobus tenellus* (Pursh) Britton. (*Astragalus tenellus* Pursh; *Astragalus multiflorus* (Pursh) A. Gray) On plains and hills from Minn., Sask. and Yukon to Neb., Colo. and Nev.—Alt. 4000-10,000 ft.—Near Empire; Ward, Boulder Co.; Swallows, between Cañon City and Pueblo; Estes Park; near mouth of Leroux Creek; Middle Park; Ft. Collins; near Boulder; mountains between Sunshine and Ward; Marshall Pass.

6. *Homalobus acerbus* (Sheld.) Rydb. (*A. acerbus* Sheld.) In the mountains of Colo.—Alt. about 8000 ft.—Glenwood Springs.

7. *Homalobus decumbens* Nutt. (*A. decumbens* A. Gray) In the mountains of Colo. and Wyo.—Steamboat Springs.

8. *Homalobus camporum* Rydb. On plains and hills from Alb. to Colo. and Utah.—Alt. 8000-10,000 ft.—Grayback mining camps and Placer Gulch; North Park.

9. *Homalobus campestris* Nutt. (*A. campestris* A. Gray; *A. convallarius* Greene) On plains from Mont. and B. C. to Colo. and Utah.—Alt. up to

10,000 ft.—Lake City; Cañon City; Como, South Park; Big South; Stove Prairie Hill; Gore Pass; Rabbit-Ear Range; North Park; Estes Park; forks of Poudre and Big South; mountains of Larimer Co.; Pinkham Creek.

10. *Homalobus decurrens* Rydb. On wooded hills in Colo.—Alt. 8000-10,000 ft.—Estes Park; Grayback mining camps and Placer Gulch; Como; Stove Prairie Hill.

11. *Homalobus hylophilus* Rydb. On wooded hillsides from Mont. and Ida. to Colo. and Utah.—Alt. about 8000 ft.—Cerro Summit; North Park, near Teller; Leadville; Empire.

12. *Homalobus tenuifolius* Nutt. From the Canadian Rockies to the mountains of Colo.—Lake City.

13. *Homalobus junciformis* (A. Nels.) Rydb. (*Astragalus junciformis* A. Nels.) On dry plains and hills from Mont. to Colo. and Utah.—Alt. about 7000 ft.—Glenwood Springs; Cedar Edge.

14. *Homalobus Hallii* (A. Gray) Rydb. (*Astragalus Hallii* A. Gray) In the mountains of Colo.—Alt. 7000-10,000 ft.—South Park; Garland; Como, South Park; Leadville; Alamosa; Dolores; Horsetooth Gulch; Como, South Park; Black Cañon.

15. *Homalobus Fendleri* (A. Gray) Rydb. (*A. Fendleri* A. Gray) On dry hills of Colo. and N. M.—Alt. 4000-7000 ft.—Mancos; Los Pinos.

16. *Homalobus flexuosus* (Dougl.) Rydb. (*Phaca flexuosa* Hook; *A. flexuosus* Dougl.) On dry plains and hills from Minn., Sask. and Alb. to Kans. and Colo.—Alt. 4000-9000 ft.—Upper Arkansas; South Park; Los Pinos; Salida; Gunnison; New Windsor; Buena Vista; Veta Pass; Idaho Springs; Sangre de Cristo Creek; Cucharas River, below La Veta; foot-hills, Larimer Co.; Grayback mining camps and Placer Gulch; Ft. Collins; northwest of Soldier Cañon; Horsetooth Gulch; Almelia; Estes Park; near Boulder; Empire.

17. *Homalobus proximus* Rydb. On dry hills of Colo.—Arboles.

18. *Homalobus Salidae* Rydb. On hills in Colo.—Salida.

19. *Homalobus macrocarpus* (A. Gray) Rydb. (*Phaca macrocarpa* A. Gray; *A. lonchocarpus* Torr.) In open woods from Colo. and Utah to N. M.—Alt. 6000-10,000 ft.—Pagosa Springs; Thompson Park, La Plata Mountains; Turkey Creek and tributaries; Arboles; Durango.

25. PHACA L.

Upper suture not acute; pod circular or oval in cross-section.

Pod short-stipitate.

Pod not mottled, erect or ascending.

Pod ashy, with minute white hairs.

Pod glabrous.

Pod mottled, spreading or reflexed.

Leaflets linear or none; plant grayish-pubescent.

Terminal leaflet none, represented by the much produced rachis; lateral leaflets also often absent.

Leaflets present; rachis not produced.

Leaflets broadly oval or obcordate; plant glabrous.

Pod sessile.

11. *P. Wetherillii*.

1. *P. Eastwoodiae*.

2. *P. longifolia*.

3. *P. picta*.

4. *P. artipes*.

Pod over 1.2 cm. long.

Pod 2-2.5 cm. long; corolla ochroleucous.

5. *P. Candolleana*.

Pod 12-15 mm. long; corolla purple.

6. *P. cerussata*.

Pod 3-12 mm. long.

Pod ovoid; plant 3-6 dm. high; raceme many-flowered.

7. *P. Bodinii*.

Pods ellipsoid; plant usually less than 3 dm. high; raceme few-flowered.

Plant caespitose; stem slender, 1-2 dm. high, slender; leaflets 0.5-1 cm. long.

8. *P. pauciflora*.

Plant pulvinate-caespitose, almost stemless; leaflets minute.

9. *P. humillima*.

Upper suture of the pod straight or curved upwards, acute; pod in cross-section obovate.

10. *P. elatiocarpa*.

1. *Phaca Eastwoodiae* (Jones) Rydb. (*Astragalus Preussii sulcatus* Jones; *A. Eastwoodiae* Jones) In Utah and Colo.—Westwater.

2. *Phaca longifolia* (Pursh) Nutt. (*A. pictus filifolius* A. Gray) On sandy soil from S. D. and Wyo. to Colo. and N. M.—Salida; Manitou; Manitou Junction.

3. *Phaca picta* A. Gray. (*A. pictus foliosus* A. Gray) In sandy soil from Colo. and Utah to N. M.—Denver; Colorado Springs.

4. *Phaca artipes* (A. Gray) Rydb. (*Astragalus artipes* A. Gray) In the mountains of Colo.—Alt. 7000-8000 ft.—Cerro Summit; Cedar Edge; Leroux Creek.

5. *Phaca Candolleana* H. B. K. (*Astragalus triflorus* A. Gray) In dry places from Colo. to N. M. and Calif.; also Mex.—Cañon City.

6. *Phaca cerussata* (Sheld.) Rydb. (*Astragalus cerusatus* Sheld.) Mountain sides in Colo.—Cañon City, Fremont Co.

7. *Phaca Bodinii* (Sheld.) Rydb. (*Astragalus Bodinii* Sheld.) In valleys from Mont. to Neb. and Colo.—Alt. 4000-5000 ft.—North Park, Larimer Co.

8. *Phaca pauciflora* Nutt. (*A. leptaleus* A. Gray) In the mountains of Colo.—Alt. 7000-10,000 ft.—Mt. Harvard; North Park, Larimer Co.; Como, South Park; Gunnison; Laramie River.

9. *Phaca humillima* (A. Gray) Rydb. (*A. humillimus* A. Gray) On arid table-lands of Colo.—Mesa Verde, near Mancos River.

10. *Phaca elatiocarpa* (Sheld.) Rydb. (*Astragalus lotiflorus brachypus* A. Gray; *A. elatiocarpus* Sheld.) On plains from Minn. to Ass. to Mo., Tex. and Calif.—Cañon City; Colorado Springs.

11. *Phaca Wetherillii* (Jones) Rydb. (*Astragalus Wetherillii* Jones) Dry hills and mesas of Colo.—Grand Junction.

26. OROPHACA Britton.

Densely caespitose; flowers 8-10 mm. long; inflorescence not exceeding the leaves.

Flowers about 10 mm. long; pods puberulent.

1. *O. tridactylica*.

Flowers about 8 mm. long; pods hoary.

2. *O. aretioides*.

Broadly caespitose with prostrate branches; flowers about 6 mm. long; peduncles usually exceeding the leaves; pods hoary.

3. *O. sericea*.

1. *Orophaca tridactylica* (A. Gray) Rydb. (*Astragalus tridactylicus* A. Gray) On plains and hills of Colorado.—Alt. 5000-6000 ft.—Livermore; St. Vrain's Cañon; Ft. Collins; plains near Denver; foot-hills west of Ft. Collins; east of Black's Lake; near New Windsor.

2. *Orophaca aretioides* (Jones) Rydb. (*Astragalus sericoleucus aretioides* Jones) On dry hills and plains of Wyo. and Colo.—Alt. about 5000 ft.—Ft. Collins; vicinity of Horsetooth; plains near Denver.

3. *Orophaca sericea* (Nutt.) Britton. (*Phaca sericeus* Nutt.; *A. sericoleucus* A. Gray) On plains and hills from Neb. to Wyo. and Colo.—Julesburg.

27. **ARAGALLUS** Necker. OXYTROPE, LOCO-WEED.

Stipules adnate to the petioles only slightly at the base; pods pendant, 1-celled, many times exceeding the calyx.

Stipules decidedly adnate to the petioles; pods not pendant.

Leaves strictly pinnate; leaflets opposite.

Fruiting calyx inflated, enclosing the fruit; plants densely caespitose, less than 1.5 dm. high.

Fruiting calyx not inflated, much exceeded by the pod.

Inflorescence 1-3-flowered; plants dwarf, pulvinate.

Pods inflated, 1-celled, ovoid.

Pods not inflated, oblong, almost 2-celled.

Inflorescence many-flowered; plants mostly over 1.5 dm. high and pod oblong, not inflated.

Corolla purple, rarely white.

Leaflets linear or linear-lanceolate, not silvery-canescens.

Leaflets oblong-lanceolate to oval, silvery-canescens.

Corolla yellow or white with a purple spot on the keel.

Flowers 12-15 mm. long; pods semi-membranaceous.

Flowers 18-25 mm. long; pods coriaceous.

Leaflets verticillate.

1. *A. deflexus*.

2. *A. multiceps*.

3. *A. Hallii*.

4. *A. Parryi*.

5. *A. Lambertii*.

6. *A. sericeus*.

7. *A. monticola*.

8. *A. albiflorus*.

9. *A. Richardsonii*.

1. *Aragallus deflexus* (Pall.) Heller. (*Oxytropis deflexa* (Pall.) DC.) In the mountains from Sask. and Alaska to N. M.—Alt. 6000-11,000 ft.—Near Empire; Lake City; Como, South Park; North Park, near Teller; Georgetown; Sangre de Cristo Creek; Sargent; Twin Lakes; Alamosa; Kremmling; Carson; North Park; Arboles; Dolores; along the Conejos River, north of Antonito; Buena Vista; Empire; Hahn's Peak.

2. *Aragallus multiceps* (Nutt.) Heller. (*Oxytropis multiceps* Nutt.) On dry hills and mountains from western Neb. to Wyo. and Colo.—Alt. 4000-10,000 ft.—Table Rock; Calhan; Manitou golf links; Colorado Springs.

Aragallus multiceps minor (A. Gray) Rydb. (*Oxytropis multiceps minor* A. Gray) In the mountains of Colo.—Alt. 8000-10,000 ft.—Mountains between Sunshine and Ward; Empire; mountains of Estes Park; headwaters of Clear Creek; Caribou.

3. *Aragallus Hallii* (Bunge) Rydb. (*Oxytropis Hallii* Bunge) On high mountains of Colo.—Alt. 10,000-11,000 ft.—Little Veta Mountain.

4. *Aragallus Parryi* (A. Gray) Greene. (*Oxytropis Parryi* A. Gray) In high mountain valleys of Colo.—Georgetown.

5. *Aragallus Lambertii* (Pursh) Greene. (*O. Lambertii* Pursh) On plains, prairies, hills and table-lands from Minn. and Mont. to Mo. and Colo.—Alt. 4000-9000 ft.—Boulder; Colorado Springs; Cheyenne Cañon; headwaters of Pass Creek; Cucharas River, below La Veta; mesas near Colorado Springs; between Colorado Springs and Cripple Creek; Horsetooth Gulch; Palmer Lake; Howe's Gulch; Poudre Flats; mountains between Sunshine and Ward; near Boulder; Eldora to Baltimore; Hardin's ranch; Table Rock.

6. *Aragallus sericeus* (Nutt.) Greene. (*Oxytropis sericea* Nutt.) On hills and table-lands from N. D. and Wyo. to N. M. and Ariz.—Alt. 4000–9000 ft.—Estes Park; Sargents; La Veta; Cimarron; Grayback mining camps and Placer Gulch; Platte Cañon; Horsetooth Gulch; Campton's ranch; west of Rist Cañon; Wray; Pinkham Creek.

7. *Aragallus monticola* (A. Gray) Greene. (*O. monticola* A. Gray) On mountain ridges from Sask. and Wash. to Colo.—"Colorado"; exact locality not given.

8. *Aragallus albiflorus* A. Nels. In mountain valleys of Wyo. and Colo.—Alt. 5000–11,000 ft.—Cucharas Valley, near La Veta; butte five miles southwest of La Veta; Iron Mountain; Placer; Ft. Collins; Buena Vista; Chambers' Lake; west of Rist Cañon; Palmer Lake; Pennock's mountain ranch; Campton's ranch, North Poudre.

9. *Aragallus richardsonii* (Hook.) Greene. (*Oxytropis splendens richardsonii* Hook.) In mountain valleys from Sask. and Yukon to Colo.—Alt. 8000–10,000 ft.—North Park; Georgetown; Middle Park; Como, South Park; mountain near Veta Pass; Twin Lakes; Indian Creek Pass; Arkansas Junction, near Leadville; Eldora to Baltimore; Empire.

28. GLYCYRRHIZA L. WILD LIQUORICE.

1. *Glycyrrhiza lepidota* Nutt. Among bushes and in rich meadows from Ont. and Wash. to N. Y. and Ariz.; also in Mex.—Alt. 4000–8000 ft.—Colorado Springs; Parlin, Gunnison Co.; Alamosa; Grand Junction; Huerfano Valley, near Gardner; Arboles; Ft. Collins; Walcott; Pueblo; Denver; Poudre Cañon; Rist Cañon; near Boulder.

29. AMORPHA L. FALSE INDIGO, LEAD-PLANT.

Tall shrub; leaflets 2–5 cm. long; pods usually 2-seeded.

1. *A. angustifolia*.

Low shrubs; leaflets 5–1.5 cm. long; pods 1-seeded.

Glabrous or nearly so; spike usually solitary at the ends of the branches.

2. *A. nana*.

Densely canescent; spikes usually clustered.

3. *A. canescens*.

1. *Amorpha angustifolia* (Pursh) Boynton. (*A. fruticosa angustifolia* Pursh; *A. fruticosa* James; not L.) Along streams from S. D. and Mont. to Fla. and Colo.—Alt. 4000–5000 ft.—Sterling, Logan Co.; river flats and plains east of Ft. Collins.

2. *Amorpha nana* Nutt. (*A. microphylla* Pursh) On dry prairies from Man. to Iowa and Colo.—Palmer Lake.

3. *Amorpha canescens* Pursh. Sand-hills and prairies from Ind. and Man. to La., Tex. and Colo.—Along Platte River.

30. PSORALEA L. POME BLANCHE, INDIAN BREAD-ROOT.

Flowers small, less than 8 mm. long, in racemes or interrupted spikes; root not tuberous.

Flowers in racemes; leaves not silvery.

Racemes short and dense, elliptic or oblong; fruit globose.

1. *P. lanceolata*.

Racemes lax, more elongated; fruit ovoid.

2. *P. tenuiflora*.

Flowers in interrupted spikes; leaves silvery.

3. *P. argophylla*.

Flowers large, over 1 cm. long, in dense head-like spikes; plant with a deep-seated tuberous, farinaceous root.

Plants with long scattered hairs, not cinereous; leaflets linear to obovate.

Plant cinereous, with short appressed pubescence; leaflets broadly obovate or rounded-spatulate.

4. *P. hypogaea*.

5. *P. mephitica*.

1. *Psoralea lanceolata* Pursh. In sandy soil from Sask. to Colo. and Ariz.—Alt. 4000-7000 ft.—Colorado Springs; Wray; Manitou Junction; La Veta.

2. *Psoralea tenuiflora* Pursh. On dry plains and hills from S. D. and Mont. to Ark. and Ariz.—Alt. 4000-8000 ft.—Golden; Cucharas Valley, near La Veta; Cañon City; New Windsor, Weld Co.; Eads; Crow Creek; Cheyenne Cañon; Colorado Springs; Ft. Collins; plains and foot-hills near Boulder.

3. *Psoralea argophylla* Pursh. On plains and prairies from Wis. and Sask. to Mo. and N. M.—Denver.

4. *Psoralea hypogaea* Nutt. On dry plains from Neb. and Colo. to Tex. and N. M.—Alt. 4000-6000 ft.—Denver; Colorado Springs.

5. *Psoralea mephitica* S. Wats. In arid soil from Colo. to N. M. and Calif.—Grand Junction.

31. *PAROSELA* Car.

Perennials.

Stem and leaves perfectly glabrous.

Stem herbaceous; bracts obovate, persistent, enclosing the calyx.

1. *P. lasianthera*.

Stem low, suffruticose, branched; spikes 2-6 flowered; bracts ovate, deciduous.

2. *P. formosa*.

Stem and leaves more or less hairy.

Spike dense, crowded; petals yellow, at least at first; plant herbaceous.

Leaves digitately tri-foliate; plant low and caespitose. 3. *P. Jamesii*.

Leaves pinnately 3-7-foliate.

Leaflets of the stem-leaves at least only 3; petals turning purplish; spike in fruit about 10 mm. thick.

4. *P. elatior*.

Leaflets 5-7; petals not turning purple; spike in fruit about 15 mm. thick.

5. *P. aurea*.

Spike lax; petals purple.

Leaves pinnately 3-13 foliolate; stem scarcely spinose.

6. *P. lanata*.

Leaves uni-foliate or none; plant very spiny.

7. *P. spinosa*.

Annual; leaves glabrous.

8. *P. Dalea*.

1. *Parosela lasianthera* (A. Gray) Heller. (*Dalea lasianthera* A. Gray) In dry soil from Colo. to Tex. and N. M.—Reported from Colorado, but doubtful.

2. *Parosela formosa* (Torr.) Vail. (*Dalea formosa* Torr.) In dry soil from Colo. and Utah to Tex. and Ariz.—Platte River.

3. *Parosela Jamesii* (T. & G.) Vail. (*Dalea Jamesii* T. & G.; *Parosela Porteri* A. Nels.) In dry soil from Colo. to Tex. and N. M.—Alt. 4000-6000 ft.—Rocky Ford, Otero Co.; Walsenburg; Cañon City; Florence.

4. *Parosela elatior* (A. Gray) Vail. (*Dalea nana elatior* A. Gray; *D. rubescens* S. Wats.) Dry places from Colo. to Tex.—“Southeastern Colorado.”

5. *Parosela aurea* (Nutt.) Britton. (*Dalea aurea* Nutt.) On plains from S. D. to Texas.—“Northeastern Colorado.”

6. *Parosela lanata* (Spreng.) Britton. (*Dalea lanata* Spreng.) In dry soil from Kans. and Utah to Tex. and Ariz.; also in Mex.—On the Platte.

7. *Parosela spinosa* (A. Gray) Vail. (*Dalea spinosa* A. Gray) In arid places from Colo. to Calif. and Ariz.; also Mex.—“Colorado”; exact locality not given.

8. *Parosela Dalea* (L.) Britton. (*Dalea alopecuroides* Willd.) Prairies from Ill. and Minn. to Tex. and Mex.—Denver (*Eastwood*).

32. PETALOSTEMON Lam. PRAIRIE CLOVER.

Calyx glabrous; corolla white.

1. *P. oligophyllus*.

Calyx pubescent.

Corolla white or yellow; spike long and compact.

2. *P. compactus*.

Corolla rose or purple, very rarely white.

Leaflets usually 5.

Stem and leaves glabrous or sparingly hairy.

3. *P. purpureus*.

Stem rather densely short-hairy.

4. *P. pubescens*.

Leaflets 7-17, oblong.

5. *P. villosus*.

1. *Petalostemon oligophyllus* (Torr.) Rydb. (*P. gracile oligophyllus* Torr.) On plains from Ass. to Iowa, Colo. and Ariz.—Alt. 4000-7000 ft.—Ft. Collins; east of Colorado Springs; Cañon City; New Windsor, Weld Co.; Cucharas Valley, near La Veta; Pueblo; Poudre River; Arkansas River; Fossil Creek; Dixon Cañon; Boulder.

2. *Petalostemon compactus* (Spreng.) Sweezy. (*Dalea compacta* Spreng.; *P. macrostachyus* Torr.) On dry plains from Neb. to Wyo. and Colo.—Alt. 4000-5000 ft.—Denver; New Windsor, Weld Co.; near Timnath; Ft. Collins.

3. *Petalostemon purpureus* (Vent.) Rydb. (*P. violaceus* Michx.) On plains and prairies from Ind., Sask. and Alb. to Mo. and N. M.—Alt. 4000-7000 ft.—Colorado Springs; Boulder; La Porte, Larimer Co.; Sterling, Logan Co.; Cucharas Valley, near La Veta; Denver; Ft. Collins; Spring Cañon; Horsetooth Gulch; Boulder.

4. *Petalostemon pubescens* A. Nelson. Plains of Colo.—Berwind.

5. *Petalostemon villosus* Nutt. In sandy soil from Sask. and Mont. to Mo. and Colo.—Alt. 4000-5000 ft.—Sterling, Logan Co.

33. HEDYSARUM L.

Calyx-teeth shorter than the tube; reticulations of the pod polygonal.

1. *H. marginatum*.

Calyx-teeth longer than the tube; reticulations of the pods transversely elongated, usually reaching from the middle to the margins, without cross-veins.

Leaflets elliptic-oblong, not fleshy; flowers 12-15 mm. long, purple; bracts lanceolate-subulate, 3-5 mm. long; internodes of the fruit 3-5.

2. *H. pabulare*.

Leaflets linear-oblong, somewhat fleshy; flowers about 10 mm. long, rose-purple; bracts lanceolate, 1.5-2 mm. long; internodes of the fruit 1-3.

3. *H. carnosulum*.

1. *Hedysarum marginatum* Greene. (*H. Uintahense* A. Nels.) On wooded hillsides of Wyo. and Colo.—Alt. up to 9000 ft.—Near La Plata Post Office; Pagosa Springs; Hesperus.

2. *Hedysarum pabulare* A. Nelson. (*H. Bakeri* Greene) On hills of Colo. and N. M.—Alt. 6000-7000 ft.—Mancos; Cimarron; Cañon City, Fremont Co.; Dolores; Palisades.

3. *Hedysarum carnosulum* Greene. On dry hills from Colo. to N. M. and Ariz.—Cañon City; Cedar Hills.

34. **ONOBRYCHIS** Scop. SAND-POIN.

1. *Onobrychis Onobrychis* (L.) Rydb. (*O. sativa* Lam.) Cultivated and occasionally escaped from Mont. to Colo.—Alt. about 8000 ft.—Walsenburg.

33. **VICIA** L. VETCH.

Racemes 3-40-flowered; flowers 1-2.5 cm. long.

Leaves decidedly pubescent.

Stipules semi-sagittate, not toothed.

1. *V. caespitosa*.

Stipules broadly semi-hastate, strongly toothed.

2. *V. trifida*.

Leaves glabrous or sparingly pubescent when young.

Leaflets linear or oblong to oval, not toothed.

Leaflets oblong or linear, rather thick and strongly veined.

Stipules narrowly semi-sagittate; often entire.

Leaflets elongated, narrowly linear; plant low.

3. *V. sparsifolia*.

Leaflets, at least the upper ones, oblong or linear-oblong; plant tall, climbing.

4. *V. dissitifolia*.

Stipules broadly semi-hastate or semi-orbicular in outline, sharply toothed.

5. *V. oregana*.

Leaflets usually oval, thin and not strongly veined.

6. *V. americana*.

Leaflets obovate-cuneate, truncate and toothed at the apex.

7. *V. californica*.

Racemes 1-2-flowered; flowers 5-6 mm. long.

8. *V. producta*.

1. *Vicia caespitosa* A. Nelson. In mountain valleys of Wyo. and Colo.—Alt. 5000-7500 ft.—Dixon Cañon Creek; Horsetooth Gulch; Cache la Poudre; Ft. Collins; Manitou; Colorado City.

2. *Vicia trifida* D. Dietr. In river valleys from Minn. and Mont. to Neb. and Colo.—Alt. 4000-9000 ft.—Mesas near Pueblo; Cucharas River, below La Veta; Veta Pass; butte five miles southwest of La Veta; mesas near Colorado Springs; Ft. Collins; Routt Co.; Campton's ranch, North Poudre; Moon's ranch; Spring Cañon; Empire.

3. *Vicia sparsifolia* Nutt. (*Lathyrus linearis* Nutt.; *V. linearis* Greene) On prairies and in valleys from Man., Alb. and Ida. to Kans. and Calif.—Alt. 4000-10,000 ft.—Florissant; Denver; Arboles; Turkey Creek and tributaries; Roswell; Grayback mining camps and Placer Gulch; Table Rock.

4. *Vicia dissitifolia* (Nutt.) Rydb. (*Lathyrus dissitifolius* Nutt.) In valleys of Neb. and Colo.—Alt. 4000-9000 ft.—Lake City; Bob Creek, West La Plata Mountains; Colorado Springs; Mancos Cañon; Roswell; Green Mountain Falls; Walcott; New Windsor; Dillon Cañon, Trinidad; Empire.

5. *Vicia oregana* Nutt. (*V. Americana truncata* Port. & Coult., in part.) On river banks from Minn., Sask. and Wash. to Kans. and Calif.—Alt. 4000-10,000 ft.—Palmer Lake; Denver; headwaters of Sangre de Cristo Creek; Upper La Plata Cañon; Mancos.

6. *Vicia americana* Muhl. On prairies and in rich river valleys from N. B. and Ida. to Va. and Ariz.—Alt. 4000-10,000 ft.—Cucharas River, below La Veta; North Cheyenne Cañon; Glenwood Springs; White River Plateau; Walsenburg; Walcott, Eagle Co.; Cerro Summit; southeast of Ouray; Big Creek Gulch; Empire.

7. *Vicia californica* Greene. In river valleys from Calif. and Wyo. to Colo.—Alt. about 7500 ft.—A doubtful specimen from Ridgeway.

8. *Vicia producta* Rydb. On gravelly hills and sides of cañons from Colo. and Utah to N. M. and Ariz.—Alt. 7000–8000 ft.—Butte five miles southwest of La Veta; Brantly Cañon, Las Animas Co.; Spring Cañon.

34. LATHYRUS L. VELCHLING, MARSH PEA.

Flowers less than 18 mm. long; corolla white.

Leaflets oval to oblong.

1. *L. leucanthus*.

Leaflets linear.

2. *L. arizonicus*.

Flowers about 2 cm. or more.

Corolla purple.

Stipules large and broad, about half as long as the leaflets.

3. *L. utahensis*.

Stipules narrow, less than half as long as the leaflets.

Leaflets elliptic to oval; upper leaves at least with well developed tendrils.

4. *L. decapetalus*.

Leaflets linear or nearly so; tendrils reduced to cusps or small appendages.

Plant glabrous or nearly so.

5. *L. ornatus*.

Plant decidedly villous-pubescent.

6. *L. incanus*.

Corolla white or yellowish.

7. *L. laetivirens*.

1. *Lathyrus leucanthus* Rydb. Hillsides, among bushes and open woods, in Colo. and N. M.—Alt. 8000–11,000 ft.—Empire; Veta Pass; Ojo; above Mancos; Boulder; Tennessee Pass, Lake Co.; Pass Creek; mountain near Veta Pass; Rico, Dolores Co.; West Indian Creek; Los Pinos (Bayfield); North Park, near Teller; Van Boxle's ranch, above Cimarron; Victoria; Leroux Creek; Michigan Fork; Spicer.

2. *Lathyrus arizonicus* Britton. On wooded hillsides from Colo. to Ariz.—Alt. 8000–11,000 ft.—West Mancos Cañon; Mt. Hesperus; Grayback mining camps and Placer Gulch; Pass Creek; Iron Mountain; West Indian Creek.

3. *Lathyrus utahensis* Jones. In valleys of Utah and Colo.—Parrott; Durango.

4. *Lathyrus decapetalus* Pursh. On plains and table-lands from Colo. and Utah to N. M. and Ariz.—Alt. 7000–8000 ft.—Cato; Cucharas River, below La Veta; Calhan; Mancos; Palmer Lake; Robinson; Mancos Cañon; Swallows, between Pueblo and Cañon City; Gunnison; Sapinero.

5. *Lathyrus ornatus* Nutt. On prairies and plains, S. D. and Wyo. to Ind. Terr. and Colo.—Alt. 4000–8000 ft.—Mesas near Colorado Springs; Dillon Cañon; along Conejos River, north of Antonito; Dolores; Colorado City.

6. *Lathyrus incanus* (Rydb. & Smith) Rydb. (*L. ornatus incanus* Rydb. & Smith.) On sandy plains from Neb. and Wyo. to Colo. and Utah.—Alt. 4000–8000 ft.—Table Rock; Palmer Lake; Calhan.

7. *Lathyrus laetivirens* Greene. In the mountains of Colo.—Alt. about 8000 ft.—Cerro Summit; Steamboat Springs.

Order 28. GERANIALES.

Plants destitute of secreting glands or cells in the tissue.

Styles united around a central column from which they break at maturity.

Fam. 72. GERANIACEAE.

Styles distinct or permanently united.

Styles distinct or partly united; the tips and the stigmas free.

Leaves simple; stamens 5.

73. LINACEAE.

Leaves compound; stamens 10–15.

74. OXALIDACEAE.

Styles and stigmas permanently united.

75. ZYGOPHYLLACEAE.

Plants with secreting glands often in the leaves or only in the bark.

76. RUTACEAE.

Family 72. **GERANIACEAE** J. St. Hill. **GERANIUM** FAMILY.

Leaves in ours digitately divided or lobed; tails of the ripening carpels dehiscent, merely arched, glabrous on the inner face. 1. **GERANIUM**.

Leaves pinnately dissected; tails of the ripening carpels, if dehiscent, twisted below and bearded on the inner face. 2. **ERODIUM**.

1. **GERANIUM** L. CRANEBILL, GERANIUM.

Petals 1-2 cm. long.

Plant erect, tall, scarcely caespitose; divisions of the leaves rhombic in outline; the terminal tooth much longer than the rest; petals white (sometimes slightly tinged with rose) and purple-veined.

Lower part of the stem glabrous or with scattered spreading villous or glandular hairs. 1. *G. Richardsonii*.

Lower part of the stem with short reflexed and appressed hairs.

Slender; leaves and calyx sparingly pubescent. 2. *G. gracilentum*.

Stout; calyx and leaves densely pubescent, the latter almost grayish.

Veins of the petals weak; calyx only sparingly glandular.

3. *G. Cowenii*.

Veins of the petals very strong; calyx densely glandular.

4. *G. nervosum*.

Plant more or less caespitose; stems ascending or spreading; divisions of the leaves obovate-cuneate; the terminal tooth only slightly longer than the rest; petals purplish.

Petals broadly obovate to obcordate; light purple with darker veins.

Stem glandular-villous with long spreading hairs.

Teeth of the leaves ovate to lanceolate, acute.

5. *G. Parryi*.

Teeth of the leaves broadly ovate, abruptly short-acuminate.

6. *G. Pattersonii*.

Lower part of the stem grayish-pubescent with reflexed hairs, not glandular.

Teeth of the leaves very short and broad; stem diffuse; petals obcordate.

7. *G. Fremontii*.

Teeth of the leaves elongated, lanceolate; stem more upright; petals obovate.

8. *G. caespitosum*.

Petals narrowly obovate, dark purple; plant not at all glandular.

9. *G. atropurpureum*.

10. *G. Bicknellii*.

Petals 5-7 mm. long.

1. *Geranium Richardsonii* Fish. & Traut. In meadows from Sask. and B. C. to N. M. and Calif.—Alt. 8000-10,000 ft.—Honnold; Rabbit-Ear Pass; Bob Creek, West La Plata Mountains; Four-Mile Hill, Routt Co.; camp on Grizzly near foot of Rabbit-Ear Range.

2. *Geranium gracilentum* Greene. In mountain valleys from Colo. to N. M. and Ariz.—Alt. 6000-10,000 ft.—Headwaters of Clear Creek; Pike's Peak; Piedra; Mancos; 4 miles west of Cameron Pass; near Veta Pass; near La Plata Post Office; La Plata Cañon; Columbine, Middle Park; Box Cañon, west of Ouray; Bosworth's; Beaver Creek; bank of Elk River, Routt Co.; Trail Creek bottom; Rico; Silverton; northwest of Dolores.

3. *Geranium Cowenii* Rydb. In the mountains of Colo.—Alt. 6000-7000 ft.—Hills, Larimer Co.; Horsetooth Gulch; Rist Cañon; La Veta.

4. *Geranium nervosum* Rydb. In the mountains of Wyo. and Ida. to Utah and Colo.—Alt. 8000-9000 ft.—Pike's Peak; Grizzly Creek; Continental Divide, Routt Co.; Four-Mile Hill, Routt Co.; Steamboat Springs.

5. *Geranium Parryi* (Engelm.) Heller. (*G. Fremontii Parryi* Engelm.) In the mountains of Wyo. and Colo.—Alt. 6000-10,000 ft.—Pike's Peak; head-

waters of Clear Creek; Colorado Springs; Idaho Springs; Manitou; Platte Cañon; vicinity of Arthur's Rock; near Boulder.

6. *Geranium Pattersonii* Rydb. In the mountains of Colo.—Alt. 8000–12,000 ft.—Near Empire; Douglas Mountain, Empire; Gray's Peak; Ute Pass; North Cheyenne Cañon; Palmer Lake; near Narrows; Platte Cañon; Eldora to Baltimore.

7. *Geranium Fremontii* A. Gray. In the mountains of Colo.—Alt. up to 9000 ft.—Sand Creek Pass.

8. *Geranium caespitosum* James. On hills and in dry mountain valleys from Wyo. and Colo.—Alt. 5000–10,000.—Grayback mining camps and Placer Gulch; foothills of Larimer Co.; Turkey Creek and tributaries; Sangre de Cristo Creek; Horsetooth Gulch; Dixon Cañon.

9. *Geranium atropurpureum* Heller. On hills from Colo. to N. M. and Ariz.—Alt. 7000–8000 ft.—Box Cañon, west of Ouray; Arboles; Ouray; Mancos; Horsetooth Gulch; Dixon Cañon Creek; Dolores.

10. *Geranium Bicknellii* Britton. In waste places and on hillsides from N. S. and B. C. to N. Y. and Colo.—Alt. 4000–5000 ft.—Fish Creek Falls.

2. ERODIUM L.

1. *Erodium cicutarium* L. In waste places from N. S. and Ore. to N. J., Colo. and Calif.; also Mex. Introduced from Europe.—Alt. 4000–7000 ft.—Cucharas River, below La Veta; South Cheyenne Cañon; Colorado Springs; Brantly Cañon, Las Animas Co.; Deer River; Palisades; Hotchkiss; Ft. Collins; Boulder.

Family 73. LINACEAE Dumont. FLAX FAMILY.

1. LINUM L. FLAX.

Petals blue; sepals not glandular-ciliate.

Annual.

Perennial.

Petals yellow; sepals usually glandular-ciliate.

Sepals long-acuminate-aristate, twice as long as the pod.

Sepals not more than half longer than the pod.

Petals less than 1 cm. long; sepals merely keeled or slightly wing-crested.

Stem glabrous or slightly and minutely puberulent.

Lateral veins of the sepals indistinct at least below; petals 6–7 mm. long.

Lateral veins of the sepals strong; petals about 8 mm. long.

Stem densely puberulent.

Petals over 1 cm. long; sepals strongly wing-crested.

1. *L. usitatissimum*.

2. *L. Lewisii*.

3. *L. aristatum*.

4. *L. australe*.

5. *L. rigidum*.

6. *L. puberulum*.

7. *L. arkansanum*.

1. *Linum usitatissimum* L. In waste places, escaped from cultivation; native of Europe.—Ft. Collins.

2. *Linum Lewisii* Pursh. (*L. perenne* of Coult. Man.; not L.) On dry plains and hills from Mackenzie and Yukon to Tex. and Calif.; also Mex.—Alt. 5000–10,000 ft.—Cimarron; mesas near Pueblo; Ft. Collins; Los Pinos (Bayfield); Mancos; West Mancos Cañon; Veta Pass; New Windsor, Weld Co.; Palmer Lake; north of La Porte; Dixon Cañon; foot-hills, Larimer Co.; Spring Cañon; Hahn's Peak.

3. *Linum aristatum* Engelm. In arid places from Colo. and Utah to Tex. and Ariz.—"Colorado"; exact locality not given.

4. *Linum australe* Heller. On dry plains and hills from Colo. to N. M. and Ariz.; also Mex.—Alt. 4000-8000 ft.—Arboles; La Veta; Mancos Cañon; Dixon Cañon; Durango.

5. *Linum rigidum* Pursh. On dry plains and hills from Sask. and Alb. to Mo. and Colo.—Alt. 4000-7000 ft.—Livermore, Larimer Co.; foot-hills western Larimer Co.; Dillon; Durango.

6. *Linum puberulum* (Engelm.) Heller. (*L. rigidum puberulum* Engelm.) On dry plains and hills from Colo. and Nev. to Tex. and Calif.—Alt. 4000-6000 ft.—Grand Junction; Walsenburg.

7. *Linum arkansanum* Osterh. Sandy soil from Neb. and Colo. to Kans. and Tex.—Rocky Fork, Otero Co.

Family 74. **OXALIDACEAE** Lindl. WOOD-SORREL FAMILY.

Plants acaulescent, perennial with bulb-like rootstock; corolla rose-violet.

1. *IONOXALIS*.

Plants caulescent, not succulent, annuals or perennials with slender rootstock; corolla yellow.

2. *XANTHOXALIS*.

1. *IONOXALIS* Small. VIOLET WOOD-SORREL.

1. *Ionoxalis violacea* (L.) Small. (*Oxalis violacea* L.) On prairies and in valleys from New England and Minn. to Fla. and Colo.—Glen Eyrie.

2. *XANTHOXALIS* Small. YELLOW WOOD-SORREL, SOURGRASS.

Inflorescence umbellike; pods pubescent.

1. *X. stricta*.

Inflorescence dichotomous-cymose; pods glabrous.

2. *X. coloradensis*.

1. *Xantoxalis stricta* (L.) Small. (*Oxalis stricta* L.) In woods, cultivated soil and roadsides, from N. S. and S. D. to Fla., Tex. and Colo.—Alt. 4000-8000 ft.—Boulder; Pagosa Springs; foot-hills, Larimer Co.; gulch west of Pennock's; mountains northeast of Dolores; Howe's Gulch; Redstone; Horsetooth Gulch.

2. *Xantoxalis coloradensis* Rydb. In gulches and in river valleys of Colo. and Black Hills of S. D.—Alt 5000-9000 ft.—Gulch in foot-hills, Larimer Co.; Sangre de Cristo Creek; New Windsor, Weld Co.; along Poudre; Redstone; Ft. Collins; Mason's river-front farm.

Family 75. **ZYGOPHYLLACEAE** Lindl. CALTROP FAMILY.

Herbs; albumen none; fruit not villous; carpels 10-12.

1. *KALSTROEMIA*.

Shrubs; albumen horny; fruit villous; carpels 5.

2. *COVILLEA*.

1. *KALSTROEMIA* Scop.

Sepals lanceolate, appressed-pubescent.

1. *K. maxima*.

Sepals linear-subulate, bristly hirsute.

2. *K. hirsutissima*.

1. *Kalstroemia maxima* (L.) T. & G. (*Tribulus maximus* L.) Waste places and sandy soil in the Gulf States.—Rocky Ford.

2. *Kalstroemia hirsutissima* Vail. On plains and prairies from Kans. and Colo. to Tex. and N. M.; also Mex.—Cañon City; Pueblo.

2. **COVILLEA** Vail. CREOSOTE BUSH.

1. *Covillea tridentata* (DC.) Vail. (*Larrea mexicana* Moricand) Arid districts from Colo. and Utah to Tex. and S. Calif.—"So. Colo.," exact locality not given.

Family 76. **RUTACEAE** Juss. RUE FAMILY.

Fruit a capsule; leaves unifoliolate; stamens 8.

1. **THAMNOSMA**.

Fruit an indehiscent samara; leaves 3-foliolate; stamens 4-5.

2. **PTELEA**.

1. **THAMNOSMA** Torr. & Frem.

1. *Thamnosma texanum* Torr. Dry plains from Colo. to Tex. and N. Mex.; also in Mex.—Alt. up to 5400 ft.—Soda spring ledge, Cañon City (*Brandegee*).

2. **PTELEA** L. HOP-TREE, WATER ASH.

Samara truncate at the apex.

1. *P. angustifolia*.

Samara emarginate at the apex.

2. *P. crenulata*.

1. *Ptelea angustifolia* Benth. Along streams from Colo. to Tex. and N. M.; also in Mex.—Cañon City; Florence.

2. *Ptelea crenulata* Greene. Along streams from Colo. to N. M. and Calif.—Brantly Cañon, Las Animas Co.

Order 29. **POLYGALALES**.

Family 77. **POLYGALACEAE** Reichenb. MILKWORT FAMILY.

1. **POLYGALA** L. MILKWORT.

Stems herbaceous, unarmed; keel with a fimbriate crest.

Perennial; leaves alternate.

Annual; leaves verticillate.

More or less spiny undershrubs; keel not crested, but with a beak.

Plant 5-15 cm. high; flowers 7-10 mm. long.

Plant 6-10 dm. high; flowers 3-4 mm. long.

1. *P. alba*.

2. *P. verticillata*.

3. *P. subspinoso*.

4. *P. acanthoclada*.

1. *Polygala alba* Nutt. On plains from S. D. to Tex. and Ariz.—Exact locality not given.

2. *Polygala verticillata* L. On grassy places from Que. and Sask. to Fla. and Colo.—Clear Creek.

3. *Polygala subspinoso* S. Wats. On dry mesas from Colo. and Nev. to N. M. and Ariz.—Alt. about 5000 ft.—Grand Junction; Gunnison Mesa.

4. *Polygala acanthoclada* A. Gray. In dry valleys from Colo. and Nev. to Ariz.—San Juan Valley.

Order 30. **EUPHORBIALES**.

Styles and stigmas distinct or mainly so, cleft or foliaceous; ovary 3-celled (rarely 2-celled); land-plants.

78. **EUPHORBIACEAE**.

Styles united by pairs; ovary 4-celled; small water- or mud-plants.

79. **CALLITRICHACEAE**

Family 78. **EUPHORBIACEAE** St. Hill. SPURGE FAMILY.

Flowers not in an involucre; calyx of several sepals.

Petals present, at least in the staminate flowers.

Stamens 6; filaments distinct.

1. *CROTON*.

Stamens 10; filaments monadelphous.

2. *DITAXIS*.

Corolla wanting; stamens 1-3.

3. *TRAGIA*.

Flowers in involucre; calyx represented by minute scales at the base of filament-like pedicels.

Glands of the involucre with petal-like appendages; these however sometimes much reduced.

Leaves all opposite.

Glands of the involucre 4; leaves inequilateral, usually oblique at the base.

4. *CHAMAESYCE*.

Glands of the involucre 5; leaves equilateral, not oblique at the base.

5. *ZYGOPHYLLIDIUM*.

Leaves alternate or scattered, at least below the inflorescence; bracts petal-like.

6. *DICHROPHYLLUM*.

Glands of the inflorescence without petal-like appendages; entirely naked or with a crescent-like horn.

Stem topped by an umbel; stipules none; involucre in open cymes, each with 4 glands and entire or toothed lobes.

7. *TITHYMALUS*.

Stem not topped by an umbel; stipules gland-like; involucre in cluster-like cymes; each with a single gland or rarely with 4 glands and fimbriate lobes.

8. *POINSETTIA*.

1. **CROTON** L.

1. *Croton texensis* (Klotzsch) Muell. Arg. In sandy soil from Ill. and Wyo. to Ala. and Ariz.; also in Mex.—Alt. 4000-6000 ft.—New Windsor; Crow Creek; Cañon City; Longmont; Boulder; La Salle.

2. **DITAXIS** Vahl.

1. *Ditaxis humilis* (Engelm. & Gray) Pax. (*Argythamnia humilis* Muell.) On prairies from Kans. and Colo. to La. and Tex.—“Southern Colorado.”

3. **TRAGIA**.

1. *Tragia ramosa* Torr. In dry soil from Mo. and Colo. to Tex. and Ariz.; also Mex.—Alt. 4000-6000 ft.—Boulder; Denver; Castle Rock; Larimer Co.; Arboles; Walsenburg; Trinidad; Horsetooth Gulch; Spring Cañon; gulch west of Pennock's; Ute Creek; Pennock's; Spring Cañon.

4. **CHAMAESYCE** S. F. Gray. SPURGE.

Leaves entire.

Annuals or biennials.

Plants prostrate; leaf-blades nearly orbicular.

1. *C. serpens*.

Plants more or less ascending or erect; leaf-blades linear or linear-lanceolate.

Capsule less than 1.5 mm. long.

2. *C. revoluta*.

Capsule about 2 mm. long or more.

Appendages of the glands conspicuous, white.

3. *C. petaloidea*.

Appendages inconspicuous, greenish-white, or obsolete.

4. *C. flagelliformis*.

Perennials.

Leaves glabrous.

Glands transversely oval; appendages fan-shaped, white, petaloid.

5. *C. albomarginata*.

Glands oval; appendages crescent-shaped, much narrower than the gland, greenish.

6. *C. Fendleri*.

Leaves pubescent.

7. *C. lata*.

Leaves toothed, but sometimes only at the apex.

Capsule, stem and leaves glabrous.

Seeds strongly transversely wrinkled.

Seeds pitted or irregularly and faintly wrinkled.

Seeds deeply and irregularly pitted.

Seeds faintly pitted or wrinkled.

Leaves oblong; seeds usually with a white bloom.

Leaves linear; seeds brownish, usually without bloom.

Capsule, stem and leaves pubescent.

8. *C. glyptosperma*.

9. *C. rugulosa*.

10. *C. serpyllifolia*.

11. *C. albicaulis*.

12. *C. stictospora*.

1. *Chamaesyce serpens* (H. B. K.) Small. (*Euphorbia serpens* H. B. K.) On prairies from Ont. and S. D. to Fla. and Ariz.; also Mex.—New Windsor, Weld Co.

2. *Chamaesyce revoluta* (Engelm.) Small. (*E. revoluta* Engelm.) On hillsides from Tex. and Colo. to N. M.; also northern Mex.—Cañon City.

3. *Chamaesyce petaloidea* (Engelm.) Small. (*E. petaloidea* Engelm.) On prairies and hillsides, especially in sandy soils, from Iowa and Wyo. to Tex. and Colo.—Alt. 4000-7000 ft.—Boulder; La Veta; Crow Creek; Longmont; Boulder Cañon.

4. *Chamaesyce flagelliformis* (Engelm.) Rydb. (*E. petaloidea flagelliformis* Engelm.; *E. flagelliformis* Engelm.) In dry soil from Colo. to Tex. and N. M.—“Southwestern Colorado.”

5. *Chamaesyce albomarginata* (T. & G.) Small. (*E. albomarginata* T. & G.) In dry soil from Colo. and Utah to Tex. and Calif.; also Mex.—Upper Platte.

6. *Chamaesyce Fendleri* (T. & G.) Small. (*E. Fendleri* T. & G.) On dry hills, in sandy soil, from Neb. and Wyo. to Tex. and Ariz.—Alt. 4000-6000 ft.—Foot-hills near Boulder; Trinidad; Cañon City; Black's Lake; Cedar Hills.

7. *Chamaesyce lata* (Engelm.) Small. (*E. lata* Engelm.) On plains and prairies from Kans. and Colo. to Tex. and N. M.—“Southwestern Colorado.”

8. *Chamaesyce glyptosperma* (Engelm.) Small. (*E. glyptosperma* Engelm.) In sandy soil from Ont. and B. C. to Tex. and Mex.—Alt. 4000-7000 ft.—Colorado Springs; Denver; Deer Run; Cañon City; Pueblo; Boulder; Fort Collins; Manitou; New Windsor; gulch west of Soldier Cañon; Miller's ranch, between Fort Collins and La Porte; Horsetooth Gulch.

9. *Chamaesyce rugulosa* (Engelm.) Rydb. (*E. serpyllifolia rugulosa* Engelm.) In sandy soil from Wyo. to N. M. and Calif.—Mountains between Sunshine and Ward; gulch west of Soldier Cañon; between Porter and Durango.

10. *Chamaesyce serpyllifolia* (Pers.) Small. (*E. serpyllifolia* Pers.) In dry soil from Mich. and Wash. to Tex. and Calif.; also Mex.—Alt. 4000-8000 ft.—Antonito; Lyons; Arboles; Gunnison; Durango; Manitou; Parlin; Boulder Co.; Box Cañon west of Ouray; between Fort Collins and La Porte; Rocky Ford.

11. *Chamaesyce albicaulis* Rydb. (*E. albicaulis* Rydb.) In old fields and sandy soil from Neb. and Mont. to N. Mex.—Alt. 4000-5500 ft.—Foot-hills west of Fort Collins.

12. *Chamaesyce stictospora* (Engelm.) Small. (*E. stictospora* Engelm.) On prairies and plains from Kans. and Colo. to Mex. and Ariz.—Alt. 5000-7000 ft.—Cañon City; Pueblo; south of Fort Collins.

5. ZYGOPHYLLIDIUM Small.

1. *Zygophyllum hexagonum* (Nutt.) Small. (*Euphorbia hexagona* Nutt.) In river valleys from Iowa and Mont. to Tex. and Colo.—Plains near Denver.

6. DICHROPHYLLUM Kl. & Garcke. SNOW-ON-THE-MOUNTAIN.

1. *Dichrophyllum marginatum* (Pursh) Kl. & Garcke. (*Euphorbia marginata* Pursh) In pastures from Minn. and Mont. to Tex. and Colo.—Alt. 4000-7000 ft.—Rocky Mountains; Boulder; sources of the Platte; Fort Collins; New Windsor; Dry Creek, Larimer Co.; La Veta; Denver; Nepesta.

7. TITHYMALUS Kl. & Garcke. SPURGE.

Leaves entire; glands of the involucre with processes.

Plants perennial; processes short and blunt.

Stem-leaves linear; capsule rough; seeds smooth.

1. *T. Cyparissias*.

Stem-leaves from oblong or oblanceolate to orbicular; capsule smooth; seeds pitted.

Bracts rhombic-ovate, cuspidate; stem rather slender.

2. *T. montanus*.

Bracts rhombic-reniform, mucronate; stem stout.

3. *T. robustus*.

Plants annual; processes of the glands long and horn-like; seeds pitted.

4. *T. crenulatus*.

Leaves distinctly serrulate; plants annual or biennial; glands without processes.

Upper stem-leaves merely sessile; bracts manifestly longer than broad.

5. *T. arkansanus*.

Upper stem-leaves with small basal lobes; bracts mostly broader than long.

6. *T. missouriensis*.

1. *Tithymalus Cyparissias* (L.) Lam. (*Euphorbia Cyparissias* L.) Escaped from cultivation from Mass. and Colo. to Va.—Fort Collins.

2. *Tithymalus montanus* (Engelm.) Small. (*Euphorbia montana* Engelm.) On dry hills from Colo. and Utah to Tex. and Ariz.—Alt. 6000-8000 ft.—Cimarron; Buena Vista.

3. *Tithymalus robustus* (Engelm.) Small. (*E. montana robusta* Engelm.) On dry hills from Mont. and S. D. to Colo. and Ariz.—Alt. 4000-8000 ft.—Cimarron; Cucharas River, La Veta; Colorado Springs; Alamosa; Larimer Co.; Gunnison; Arboles; Fort Collins; Longmont; Pike's Peak trail; Poudre River; Fort Collins; along Purgatory River; Fossil Creek; Rist Cañon; Colorado Springs.

4. *Tithymalus crenulatus* (Engelm.) Heller. (*E. crenulata* Engelm.) On hillsides from Colo. to Calif. and Ariz.—Mancos; Horsetooth Gulch.

5. *Tithymalus arkansanus* (Engelm. & Gray) Kl. & Garcke. (*E. arkansana* Engelm. & Gray) In dry soil from Mo. and S. D. to Ala. and Ariz.—Alt. 4000-6000 ft.—Larimer Co.; Boulder; Horsetooth Gulch.

Tithymalus arkansanus coloradensis (Norton) Rydb. Floral leaves elliptical.—McElmo Cañon; Larimer Co.

6. *Tithymalus missouriensis* (Norton) Small. (*Euphorbia dictyosperma* Coulter; not F. & M.; *E. arkansana missouriensis* Norton) In sandy soil from Iowa and Wash. to Kans. and N. M.—Denver.

8. **POINSETTIA** Graham. SPURGE.

Seeds not prominently tubercled; glands of the involucre 3-4; leaf-blades linear or linear-lanceolate.

Seeds prominently tubercled; gland of the involucre solitary; leaf-blades ovate to lanceolate (linear-lanceolate only in one variety).

1. *P. cuphosperma*.2. *P. dentata*.

1. *Poinsettia cuphosperma* (Boiss.) Small. (*Euphorbia cuphosperma* Boiss.) In cañons and hillsides from S. D. and Wyo. to Tex. and Ariz.; also Mex.—Alt. 5000-7000 ft.—Colorado Springs; Manitou; Cañon City.

2. *Poinsettia dentata* (Michx.) Small. (*Euphorbia dentata* Michx.) In moist soil from Pa. and S. D. to La., Mex. and Utah.—Alt. 4000-6000 ft.—Boulder; Fort Collins; New Windsor. A rare variety with nearly linear leaves.—Fort Collins.

Family 79. **CALLITRICHACEAE** Lindl. WATER STARWORT FAMILY.1. **CALLITRICHE** L. WATER STARWORT.

1. *Callitriche palustris* L. In shallow running water from N. S. and B. C. to Fla. and Calif.; also Europe, Asia and S. Am.—Leroux Parks, Delta Co.; Ft. Collins; Boulder.

Order 31. **SAPINDALES**.

Low annual herbs; stamens twice as many as the sepals and petals.

80. **LIMNANTHACEAE**.

Shrubs or trees; stamens usually as many as the petals or sepals.

Stamens opposite the sepals.

Plants with resiniferous tissue; fruit drupaceous; seeds without aril; leaves in ours compound.

81. **SPONDIACEAE**.

Plants without resiniferous tissue; fruit a loculicidal capsule; seed with a fleshy aril; leaves simple.

82. **CELASTRACEAE**.

Stamens alternate with the sepals; fruit a double samara; leaves opposite.

83. **ACERACEAE**.Family 80. **LIMNANTHACEAE** Lindl. FALSE MERMAID FAMILY.1. **FLOERKIA** Willd. FALSE MERMAID.

1. *Floerkia occidentalis* Rydb. In wet soil from Wyo. and Wash. to Colo. and Utah.—Steamboat Springs; Gunnison Co.

Family 81. **SPONDIACEAE** Kunth. SUMAC FAMILY.

Drupe with glabrous outer coat; stone ribbed; plants poisonous to touch.

1. **RHUS**.

Drupe with pubescent outer coat; stone smooth; plants not poisonous.

2. **SCHMALTZIA**.1. **RHUS** L. POISON OAK, POISON IVY.

1. *Rhus Rydbergii* Small. On plains, hills and among bushes from Mont. and B. C. to Nebr. and Colo.—Alt. 4000-5000 ft.—Ft. Collins; foot-hills near Boulder.

2. **SCHMALTZIA** Desv. SUMAC.

Leaflets 9-31; flowers appearing after the leaves.

1. *S. glabra*.

Leaflets 1-3; flowers appearing before the leaves.

2. *S. trilobata*.

1. *Schmaltzia glabra* (L.) Small. (*Rhus glabra* L.) Along streams, in thickets and on hills from N. S. and B. C. to Fla. and Ariz.—Alt. 4000-6000 ft.—Cheyenne Cañon, near Pike's Peak; Lower Boulder Cañon, Boulder Co.; foot-hills, Larimer Co.; vicinity of Arthur's Rock; gulch west of Pennock's.

2. *Schmaltzia trilobata* (Nutt.) Small. (*Rhus trilobata* Nutt.) On dry hills from Ass. and Wash. to Mo., Tex. and Calif.; also Mex.—Alt. 4000-8000 ft.—Boulder; Colorado Springs; Buena Vista; Trinidad; southeast of La Veta; Manitou; Ft. Collins; Cedar Hills; along Poudre; Rist Cañon; Horsetooth Gulch; gulch west of Soldier Cañon; Spring Cañon; Howe's Gulch.

Family 82. **CELASTRACEAE** Lindl. STAFF-TREE FAMILY.

Petals, sepals and stamens 4; ovary 2-celled; each cell with 2 ovules; depressed or trailing evergreen shrubs, not spiny.

1. **PACHYSTIMA**.

Petals and sepals 5; stamens 5-10; ovary 1-celled with 2 ovules; small erect shrubs with angled, green, often spinescent branches.

2. **FORSELLESIA**.1. **PACHYSTIMA** Raf.

1. *Pachystima Myrsinites* (Pursh) Raf. In woods from Mont. and B. C. to N. M. and Calif.—Alt. 6000-10,000 ft.—Headwaters of Clear Creek; near Empire; Mt. Ouray; Crystal Creek; East and West Indian Creek; near La Plata Post Office; Steamboat Springs; Glenwood Springs; Four-Mile Hill, Routt Co.; west and southeast of Ouray; Rico; Big Creek Gulch, Routt Co.; Trapper's Lake; Black Cañon of Gunnison; Ragged Mountain, Gunnison Co.; mountains near Silverton; bank of Fish Creek; Hematite.

2. **FORSELLESIA**. Greene.

Stamens 5-7.

1. *F. meionandra*.

Stamens 10.

2. *F. spinescens*.

1. *Forsellesia meionandra* (Koehne) Heller. (*Glossopetalon meionandrum* Koehne) In arid regions of southern Colorado. Exact location not given.

2. *Forsellesia spinescens* (A. Gray) Greene. (*Glossopetalon spinescens* A. Gray) In desert regions from Ore. to Tex. and Calif.—Grand Junction; Hovensweep Castle (*Brandegee*).

Family 83. **ACERACEAE** J. St. Hil. MAPLE FAMILY.

Leaves with simple or rarely digitately divided blades; flowers polygamo-dioecious.

1. **ACER**.

Leaves with pinnately compound blades; flowers dioecious.

2. **RULAC**.1. **ACER** L. MAPLE.

Flowers polygamous in racemes or corymbs; petals and sepals both present; disk well developed; lobes of the leaves toothed.

1. *A. glabrum*.

Flowers monoecious, in umbels; petals lacking; lobes of the leaves sinuate.

2. *A. grandidentatum*.

1. *Acer glabrum* Torr. In cañons, on hillsides and along streams, from W. Neb. and Wyo. to N. M. and Utah.—Alt. 4000-9000 ft.—Headwaters of Clear Creek; Hinsdale Co.; Pike's Peak; near Pagosa Peak; near La Plata Post Office; Idaho Springs; foot-hills west of Ft. Collins; South Cheyenne Cañon; Colorado Springs; Wahatoya Cañon; Ute Pass; southeast of Ouray; along Uncompahgre River near Ouray; Rist Cañon; Dillon Cañon; gulch west of Pennock's; hills northwest of Soldier Cañon; Howe's Gulch; Baxter's ranch; Big Narrows on Poudre; Ft. Collins; Dolores; North Poudre River; Campton's ranch; Horsetooth Gulch; gulch west of Dixon Cañon; Redstone; mountains between Sunshine and Ward; Eldora to Baltimore.

2. *Acer grandidentatum* Nutt. In wooded valleys and cañons from Mont. to Tex. and Ariz.—Pike's Peak.

2. **RULAC** Adans. BOX-ELDER, ASH-LEAVED MAPLE.

Twigs and petioles essentially glabrous; leaflets thin, coarsely toothed.

Twigs and petioles copiously pubescent; leaflets thick, lobed. 1. *R. Negundo*.
2. *R. texana*.

1. *Rulac Negundo* (L.) Hitchc. (*Acer Negundo* L.; *Negundo aceroides* Moench.) In low ground and along streams from Vt. and Ida. to Fla. and Tex.—Alt. 4000-7000 ft.—South Cheyenne Cañon; Colorado Springs.

2. *Rulac texanum* (Pax.) Small. (*Acer texanum* Pax.) Along rivers from Sask. and Mont. to Mo. and Ariz.—Alt. 5000-8500 ft.—Southeast of Ouray; Cucharas Valley, near La Veta; Ft. Collins; Walsenburg; Cache la Poudre; foot-hills near Boulder.

Order 32. RHAMNALES.

Sepals manifest; petals involute; fruit capsular or drupaceous; ours shrubs or trees. 84. FRANGULACEAE.

Sepals minute or obsolete; petals valvate; fruit a berry; ours vines with tendrils. 85. VITACEAE.

Family 84. FRANGULACEAE DC. BUCKTHORN FAMILY.

Fruit pulpy; petals small, clawless or wanting; stigmas usually 2.

Fruit dry; petals hooded and long-clawed; stigmas 3. 1. RHAMNUS.
2. CEANOTHUS.

1. **RHAMNUS** L. BUCKTHORN.

Leaves broadly elliptic or ovate; flowers solitary in the axils; carpels 3 or 4.

Leaves lanceolate; flowers 2 or 3 in each axil; carpels 2. 1. *R. cathartica*.
2. *R. Smithii*.

1. *Rhamnus cathartica* L. Cultivated for hedges and escaped; native of Europe.—Ft. Collins.

2. *Rhamnus Smithii* Greene. Along streams in Colo. and N. Mex.—Alt. about 7000 ft.—Pagosa Springs.

2. **CEANOTHUS** L. NEW JERSEY TEA.

Leaf-blades rounded-oval, often cordate at the base, very shining above; closely glandular-dentate. 1. *C. velutinus*.

Leaf-blades oblong to elliptic or ovate, glandular-serrate or sub-entire.

Umbels mostly terminal; leaves dull beneath, glabrate or villous.

2. *C. pubescens*.

Umbels mostly axillary; leaves silky beneath.

Leaf-blades distinctly glandular-serrate; plant not spiny. 3. *C. subsericeus*.

Leaf-blades obsoletely denticulate or entire; branches often ending in spines.

4. *C. Fendleri*.

1. *Ceanothus velutinus* Dougl. On hillsides from Mont. and B. C. to Colo. and Calif.—Alt. 6000-7000 ft.—Headwaters of Clear Creek; near Empire; Steamboat Springs; Walton Creek; Four-Mile Hill, Routt Co.; Sheephorn Divide; between Pallas and Sydney; Poudre Cañon; mountains between Sunshine and Ward; Pinkham Creek; Beaver Cañon.

2. *Ceanothus pubescens* (T. & G.) Rydb. (*C. ovatus pubescens* T. & G.) In sandy soil from Mich. and S. D. to Mo. and Colo.—Alt. 4000-8000 ft.—Foot-hills, Larimer Co.; Colorado Springs; Pennock's mountain ranch; Horsetooth Mountain; Monument; Boulder.

3. *Ceanothus subsericeus* Rydb. Foot-hills of Colo.—Alt. about 6000 ft.—Larimer Co.

4. *Ceanothus Fendleri* A. Gray. In woods and on hillsides from S. D. and Wyo. to N. M. and Ariz.—Alt. 5000-9000 ft.—Headwaters of Clear Creek; Denver to Idaho Springs; Sangre de Cristo Creek; Mancos; Pagosa Springs; Grayback mining camps and Placer Gulch; Boulder; west of Ouray; Mt. Harvard; southeast of Ouray; Rist Cañon; vicinity of Arthur's Rock, Larimer Co.; Leroux Creek; Horsetooth Gulch; Pennock's mountain ranch; Horsetooth Mountain; mountains between Sunshine and Ward.

Family 85. VITACEAE Lindl. GRAPE FAMILY.

Hypogynous disk present; leaf-blades simple.

1. *VITIS*.

Hypogynous disk wanting or obsolete; leaf-blades digitately 5-7-foliolate.

2. *PARTHENOCISSUS*.

1. *VITIS* L. GRAPES.

1. *Vitis vulpina* L. (*Vitis riparia* Michx.) Along streams from N. B. and N. D. to W. Va., Tex. and Colo.—Alt. 4000-9000 ft.—Walsenburg; Dixon Cañon, Larimer Co.; Ft. Collins; banks of Cache la Poudre; Rist Cañon; gulch west of Pennock's; Boulder.

2. *PARTHENOCISSUS* Planch. VIRGINIA CREEPER, AMERICAN IVY.

Aerial rootlets present; tendrils with disks.

1. *P. quinquefolia*.

Aerial rootlets lacking; tendrils without disks.

2. *P. laciniata*.

1. *Parthenocissus quinquefolia* (L.) Planch. In woods and on banks from Que. and Man. to Fla. and Tex.—Reported from Colorado (*Meehan*), but doubtful.

2. *Parthenocissus vitacea* Hitchc. (*P. quinquefolia laciniata* Planch.; *P. laciniata* Small) On river banks and in woods from Mich. and Wyo. to Ohio and Ariz.—Alt. 4000-6000 ft.—Foot-hills, Larimer Co.; Cheyenne Cañon; Ft. Collins; North Cheyenne Cañon; Golden; vicinity of Arthur's Rock; near Boulder.

Order 33. MALVALES.

Family 86. MALVACEAE Neck. MALLOW FAMILY.

Style-branches filiform, longitudinally stigmatose anteriorly; carpels numerous, indehiscent, containing a single ovule and a reniform seed.

Stamens simply monadelphous; flowers involuclled.

Petals notched at the apex; carpels beakless without internal processes.

1. MALVA.

Petals erose at the apex; carpels beaked, with an internal process above the seed.

2. CALLIRHOE.

Stamens united in a double series; flowers without involucels.

3. SIDALCEA.

Style-branches terminated by a capitate stigma.

Lower seed at least from an ascending ovule; calyx more or less bractioled.

Ovule and seed solitary, conformed to the rounded cavity of the carpel.

4. MALVASTRUM.

Ovules 1-3 and seeds 1-2; the cells of the carpels more or less extended and empty above.

5. SPHAERALCEA.

Lower seed at least resupinate-pendulous; no involucels under the calyx, or these represented by 1-3 setaceous bractlets.

Carpels 1-ovuled, the cell filled with the seed.

6. SIDA.

Carpels 3-9-ovuled, dehiscent apically and dorsally.

7. ABUTILON.

1. MALVA L. MALLOW.

Calyx not reflexed in fruit.

Plant erect; leaves crisp.

1. *M. crispa*.

Plant procumbent; leaves not crisp.

2. *M. rotundifolia*.

Calyx large, reflexed-spreading in fruit.

3. *M. parviflora*.

1. *Malva crispa* L. In waste places, escaped from gardens, from N. S. and S. D. to N. J. and Colo.—Ft. Collins.

2. *Malva rotundifolia* L. In waste places, naturalized from Europe; from Mass. and Minn. to Ga. and Utah.—Alt. up to 7500 ft.—North of La Veta; Hotchkiss; near Boulder; Denver.

3. *Malva parviflora* L. In waste places, naturalized from Europe; from Mont. and B. C. to Fla., Tex. and Calif.—Hotchkiss.

2. CALLIRHOE Nutt. POPPY MALLOW.

1. *Callirhoe involucrata* (T. & G.) A. Gray. On plains and in sandy soil from Mo. and Wyo. to Tex. and Utah.—Ft. Collins; Cheyenne Cañon; Yuma; Colorado Springs.

3. SIDALCEA A. Gray.

Inflorescence and calyx densely stellate; corolla cream-colored.

1. *S. candida*.

Inflorescence and calyx sparingly hirsute; corolla purple or white.

2. *S. neo-mexicana*.

1. *Sidalcea candida* A. Gray. Along streams and in wet meadows from Wyo. to N. M. and Utah.—Alt. 7000-13,000 ft.—Lake City; La Veta; Steamboat Springs; Parlin, Gunnison Co.; Grizzly Creek; Cameron Pass; above Dix Post Office; Wahatoya Creek; West Spanish Peak; Cucharas Valley; Michigan Hill.

2. *Sidalcea neo-mexicana* A. Gray. (*S. malvaefolia* of Coult. Man.) In mountain valleys from Wyo. and Utah to N. M. and southern Calif.; also Sonora.—Alt. 6000-10,000 ft.—Pitkin; La Veta; Parlin, Gunnison Co.; Grizzly Creek; Marshall Pass; Grayback mining camps and Placer Gulch; Sangre de Cristo Creek; Piedra; valley of Arkansas; Calhan; Buena Vista; Bear River, Routt Co.; North Park; Soda Spring near north fork of the Platte; Bear River at Steamboat Springs; Grizzly Creek 16 miles north of Walden; Elk River.

4. MALVASTRUM A. Gray. FALSE MALLOW.

Plant canescent with stellate hairs; leaves 3-5-divided with 2-3-cleft divisions.

Plant low, 1-2 dm. high; middle segment of the leaves slightly longer than the others; raceme crowded. 1. *M. coccineum*.

Plant tall, 3-4 dm. high; middle segment of the leaves usually half longer than the others; raceme elongated. 2. *M. elatum*.

Plant lepidote and silvery with scale-like peltate hairs; leaves 3-parted with narrowly linear divisions or the upper simple and filiform. 3. *M. leptophyllum*.

1. *Malvastrum coccineum* (Pursh) A. Gray. On plains and in sandy valleys from Sask. and Ore. to Iowa, Tex. and Utah.—Alt. 4000-9000 ft.—Ft. Collins; Cimarron; Deer River; Manitou; Cañon City; Arboles; Cucharas River below La Veta; Sangre de Cristo Creek; mesas near Pueblo; Trinidad; along Platte River, Denver; Mancos; New Windsor, Weld Co.; Rocky Ford; Montrose; Lamar; Quimby; Ouray; Horsetooth Gulch; Grand Junction; Colorado City.

2. *Malvastrum elatum* (Baker) A. Nelson. (*M. coccineum elatum* Baker) In dry valleys from southern Colo. and Utah to N. Mex.—Salida.

3. *Malvastrum leptophyllum* A. Gray. In dry places from western Texas to southern Utah.—Valley of San Juan and La Plata (*Brandegge*); McElmo Creek (*Eastwood*).

5. SPHAERALCEA St. Hil. GLOBE-MALLOW.

Carpels glabrous or canescent, not hirsute, lower part reticulated; leaves small, not maple-like.

Leaves lanceolate; fruit not depressed; carpels with cusp. 1. *S. cuspidata*.

Leaves round-ovate to reniform in outline; fruit depressed globose; carpels not cuspidate-tipped. 2. *S. marginata*.

Carpels thin, hirsute, the lower portion not reticulate; leaves large, maple-like.

Sepals lanceolate or ovate-lanceolate; bractlets subulate, three-fourths as long as the sepals or more. 3. *A. Crandallii*.

Sepals broadly triangular-ovate; bractlets scarcely more than half as long as the sepals.

Calyx and pedicels finely stellate; bractlets subulate; petals 2-2.5 cm. long.

4. *A. rivularis*.

Calyx and pedicels hirsute with branched hairs; bractlets lanceolate; petals 3 cm. or more long.

5. *A. grandiflora*.

1. *Sphaeralcea cuspidata* (A. Gray) Britton. (*S. angustifolia cuspidata* A. Gray; *S. stellata* T. & G.; *Sida stellata* Torr.; not Cav.) In dry ground from Kans and Colo. to Tex. and Ariz.; also Sonora.—Cañon City; Pueblo; Rocky Ford.

2. *Sphaeralcea marginata* York. (*Malvastrum Munroanum* S. Wats., in part; not *Malva Munroana* Dougl.) In dry places in western Colo. and northern N. M.—Alt. up to 6000 ft.—McElmo Cañon; Grand Junction.

3. *Sphaeralcea Crandallii* Rydb. Mountains of Colo.—Alt. about 7000 ft.—Steamboat Springs.

4. *Sphaeralcea rivularis* (Hook.) Torr. (*Malva rivularis* Hook.; *Sphaeralcea acerifolia* Nutt.) Along streams from Alb. and B. C. to S. D., Colo. and Nev.—Four-Mile Hill, Routt Co.; Ragged Mountain, Gunnison Co.; Buffalo Pass; Park Range; Fish Creek Falls.

5. *Sphaeralcea grandiflora* Rydb. Mountains of Colo.—Alt. 7000-9000 ft.—Mesa Verde; west of Ouray.

6. SIDA L.

1. *Sida sagittaeifolia* (A. Gray) Rydb. (*Sida lepidota sagittaeifolia* A. Gray) Plains from Colo. to Tex. and Ariz.; also in Mex.—"Southern Colorado."

7. ABUTILON Gaertn. VELVET-LEAF, INDIAN MALLOW.

1. *Abutilon parvulum* A. Gray. In dry soil from Colo. to Tex. and Ariz.—Cañon City.

Order 34. HYPERICALES.

Styles wanting; stigma introrse; ours small water-plants. 87. ELATINACEAE.
Styles present; stigmas capitate or nearly so.

Styles in ours distinct.

Sepals persistent, united into a tube; leaves not pellucid-dotted.

Sepals distinct; leaves pellucid-dotted.

Styles wholly united.

Corolla regular or nearly so; stamens 8.

Corolla irregular; one petal spurred; stamens 5.

88. FRANKENIACEAE.

89. HYPERICACEAE.

90. CISTACEAE.

91. VIOLACEAE.

Family 87. ELATINACEAE Lindl. WATER-WORT FAMILY.

1. ELATINE L. WATER-WORT, MUD PURSLANE.

Leaves oblanceolate; flowers usually 3-merous.

Leaves obovate; flowers 2-merous.

1. *E. triandra*.

2. *E. americana*.

1. *Elatine triandra* Schkur. In shallow water from Ills. and Wyo. to Colo.—Platte River.

2. *Elatine americana* Arn. In mud and shallow water from Que. and B. C. to Va., Colo. and Calif.—Platte River.

Family 88. FRANKENIACEAE.

1. FRANKENIA L.

1. *Frankenia Jamesii* Torr. On saline plains from Colo. to Tex. and Sonora.—Bluffs about Pueblo; Rocky Ford, Otero Co.; Cañon City.

Family 89. HYPERICACEAE Lindl. ST. JOHN'S WORT FAMILY.

1. HYPERICUM L. ST. JOHN'S WORT.

Petals more than twice as long as the sepals; both usually margined with black glands.

Petals slightly exceeding the sepals; black glands none.

1. *H. formosum*.

2. *H. majus*.

1. *Hypericum formosum* H. B. K. On hillsides and mountain valleys from Colo. and Utah to Mex. and S. Calif.—Alt. 6000-10,000 ft.—South Park; Pagosa Springs; Colorado Springs; Mancos; Elk River, Garfield Co.; Marshall Pass; near Manitou, El Paso Co.; Chambers' Lake; Wahatoya Creek; Gypsum Creek Cañon; Poudre Cañon.

2. *Hypericum majus* (A. Gray) Britton. In wet meadows from Me. and B. C. to N. J. and Colo.—Alt. 4000-6000 ft.—Foot-hills, near Boulder.

Family 90. **CISTACEAE** Lindl. ROCK-ROSE FAMILY.

1. **HELIANTHEMUM** Pers. FROSTWEED.

1. *Helianthemum majus* (L.) B. S. P. (*H. canadense Walkerae* Evans) On hillsides from N. S. and S. D. to N. C. and Colo.—Douglas County.

Family 91. **VIOLACEAE** DC. VIOLET FAMILY.

Sepals more or less auricled at base.

1. *VIOLA*.

Sepals not auricled at base.

2. *CALCEOLARIA*.

1. **VIOLA** L. VIOLET.

Acaulescent; flowers scapose.

Plant stoloniferous, at least so after the flowering period.

Flowers pale blue or lilac.

1. *V. palustris*.

Flowers white.

Upper and lateral petals twice as long as broad; petioles not red-spotted.

Leaves ovate, pointed, green; lateral petals veined with purple.

2. *V. blanda*.

Leaves reniform, not pointed, glaucous; lateral petals not veined.

3. *V. Macloskeyi*.

Upper and lateral petals three times as long as broad; petioles and scapes red-spotted.

4. *V. LeConteana*.

Plant not stoloniferous; flowers blue.

Leaf-blades divided into linear lobes.

5. *V. pedatifida*.

Leaf-blades entire.

Blade strongly decurrent upon the petiole; cleistogenes horizontal.

6. *V. retusa*.

Blade not decurrent; cleistogenes erect or ascending.

Sepals lanceolate, pointed; leaves herbaceous.

7. *V. cognata*.

Sepals oblong, obtuse, 3-nerved; leaves subcoriaceous.

8. *V. nephrophylla*.

Cauliscent, leafy-stemmed.

Flowers yellow or tinged with brown.

Stems short or subcaulescent at flowering time.

Leaf-blades pedately divided into narrow segments; petals tinged with brown beneath.

9. *V. Sheltonii*.

Leaf-blades entire or merely toothed.

Blades lanceolate, tapering to a margined petiole, pubescent.

10. *V. Nuttallii*.

Blades ovate to oblong-ovate, scarcely or not at all tapering to the petiole.

11. *V. linguaefolia*.

Stems erect or ascending, bearing scattered long-petioled orbicular leaves.

12. *V. biflora*.

Flowers blue, purple or white.

Flowers white or tinged with purple beneath.

13. *V. canadensis*.

Flowers blue.

Plant rough-pubescent, 1-2 dm. high.

14. *V. retroscabra*.

Plant glabrous, 2-6 cm. high.

15. *V. bellidifolia*.

1. *Viola plustris* L. Wet soil, Lab. and Alaska to N. Y. and Colo.—Alt. 8500–10,000 ft.—Grayback mining camps; Beaver Creek; banks of Michigan River; Eldora to Baltimore.

2. *Viola blanda* Willd. Swamps and wet meadows, Newf. and B. C. to N. C. and Utah.—Alt. 8000–10,000 ft.—Caribou; headwaters of Clear Creek; Columbine.

3. *Viola Macloskeyi* F. E. Lloyd. Subalpine situations, Mont. and Ore. to Colo. and Calif.—Alt. about 9000 ft.—North Park, Larimer Co.

4. *Viola LeConteana* G. Don. (*V. blanda amoena* LeConte) Moist woodlands, N. S. and Ida. to N. C. and Colo.—Alt. about 9000 ft.—Chicken Creek.

5. *Viola pedatifida* G. Don. Prairies, Ill. to B. C. and Ariz.—Alt. about 8000 ft.—Wahatoya Cañon.

6. *Viola retusa* Greene. Woodlands and meadows, S. D. to Kans. and Colo.—Alt. about 5000 ft.—New Windsor; Ft. Collins; Timnath, Larimer Co.

7. *Viola cognata* Greene. Wet meadows, Alb. and S. D. to N. M., Ariz., Utah and Calif.—Alt. 5000–10,000 ft.—Bob Creek, West La Plata Mountains; headwaters of Sangre de Cristo Creek; mountain near Veta Pass; West Indian Creek; Cucharas Valley near La Veta; Timnath, Larimer Co.; Lake City; Ft. Collins; plains and foot-hills near Boulder.

8. *Viola nephrophylla* Greene. Meadows and thickets, Ida. and Wyo. to Colo., Ariz. and Nev.—Los Pinos.

9. *Viola Sheltonii* Torr. Western Colo. to Calif.—Alt. 8000–9000 ft.—Grand Mesa; Cerro Summit.

10. *Viola Nuttallii* Pursh. Prairies, plains and foot-hills, Man. and Mont. to Mo., N. M. and Ariz.—Alt. 4000–9000 ft.—Walsenburg; southeast of La Veta; Cucaras Valley and river near La Veta; Ft. Collins; southwest of La Veta; Rist Cañon, Larimer Co.; New Windsor, Weld Co.; plains near Denver; Grand Mesa; plains and foot-hills near Boulder.

11. *Viola linguaefolia* Nutt. (*V. vallicola* A. Nels.; *V. physalodes* Greene) Foot-hills and mountains, N. D. and Mont. to Colo. and Utah.—Alt. up to 7000 ft.—Between Meeker and Craig; mountains east of Steamboat Springs; Minturn, Eagle Co.; Cimarron; Dixon Creek; Trinidad.

12. *Viola biflora* L. Mountains of Colo.; also in Europe and Asia.—Alt. 8000–10,000 ft.—Jack Brook; headwaters of Clear Creek and alpine ridges east of Middle Park; Argentine Pass; Eldora to Baltimore.

13. *Viola canadensis* L. The typical *V. canadensis* of the east is represented in Colorado by the following subspecies:

Viola canadensis Rydbergii (Greene) House. (*V. Rydbergii* Greene) Radical leaves subreniform, as broad as long or broader, on elongated petioles; pubescent at least on the veins beneath. Rocky Mountains, Alb. and Ida. to S. D. and Colo.—Alt. 5000–9000 ft.—Ouray; Van Boxle's ranch above Cimarron; near Pagosa Peak; Mancos; Steamboat Springs; gulch of Bear River, Routt Co.; Cucharas Valley, near La Veta; Ft. Collins; Apex; Villa Grove; foot-hills, Larimer Co.; Rico; Boulder.

Viola canadensis neo-mexicana (Greene) House. (*V. neo-mexicana* Greene) Southern Colo. and N. M.—Alt. 7500–12,000 ft.—Idaho Springs; Wahatoya Cañon; Mt. Abram; about Ouray; Rico; Eldora to Baltimore.

Viola canadensis scopulorum A. Gray. (*V. scopulorum* Greene) Colo. and N. M. Low, tufted and spreading, more or less pubescent; the stipules very large, scarious.—Horsetooth Gulch.

14. *Viola retroscabra* Greene. Mountains, Colo. and N. M. to southern Calif.—Alt. 6000–10,000 ft.—Grayback mining camps; Cerro Summit; Cameron Pass; Cimarron; Mancos; along Uncompahgre River near Ouray; Breckenridge; Bob Creek; West Indian Creek; Pagosa Springs; Minturn, Eagle Co.; mountain near Veta Pass; Chambers' Lake; mountains of Estes Park, Larimer Co.

15. *Viola bellidifolia* Greene. High mountains, Wyo. and Colo.—Alt. 8000–12,000 ft.—Marshall Pass; Slide Rock Cañon, West La Plata Mountains; Alpine Tunnel; Bob Creek Divide; Graymont; Cameron Pass; Columbine; mountains of Estes Park; Chambers' Lake; Red Mountain; Gunnison; source of Leroux, Delta Co.; Eldora to Baltimore; summit of North Park Range, Larimer Co.; Rabbit-Ear Range, Routt Co.

2. CALCEOLARIA Loebl. NODDING VIOLET.

1. *Calceolaria verticillaria* (Ortega) Kuntze. (*Ionidium polygalaeifolium* Vent.; *Ionidium lineare* Torr.) Plains, Colo. and Kans. to Tex., Ariz. and Mex.—Brantly Cañon, Las Animas Co.; Cañon City.

Order 35. OPUNTIALES.

Sepals and petals 4 or 5 very unlike; * leaves ample; plants erect, not succulent, with rigid hairs.

Sepals and petals nearly alike, at least the latter numerous; leaves typically and in all ours mere scales or wanting; succulent plants armed with spines.

92. LOASACEAE.
93. CACTACEAE.

Family 92. LOASACEAE Reichenb. LOASA FAMILY.

Placentae with horizontal lamellae between the seeds; these in two rows, flat, more or less winged.

Placentae without lamellae; seeds usually prismatic.

Placentae slender, filiform; ovules in one row, 10–40; seeds minutely muricate, not striate; filaments free or nearly so.

Placentae broad, band-like; ovules in 1–2 rows, few; seeds distinctly striate, often rugose; filaments at the base united with the petals into a ring.

1. TOUTEREA Eat. & Wright.

Upper leaves entire.

All leaves pinnatifid, lobed or toothed.

Petals obtuse, spatulate, 1–2 cm. long.

Petals acute.

Petals greenish-yellow; seeds irregularly angled on the face.

Petals golden yellow to straw color; seeds not angular on the face.

Petals golden yellow, about 2 cm. long or less.

Low, less than 3 dm. high; leaves less than 6 cm. long.

Seeds merely margined.

Seeds winged.

1. *T. multicaulis*.

2. *T. multiflora*.

3. *T. lutea*.

4. *T. chrysantha*.

* Many species of *Toutheria* have petaloid staminodia of which the outer 5 sometimes are as broad as the petals and resemble them.

Leaves sinuately dentate or crenate; the lower oblanceolate-spatulate; the upper ovate-lanceolate. 5. *T. integra*.

Leaves mostly pinnately lobed; lobes of the leaves narrow, linear or lanceolate. 6. *T. densa*.

Tall, usually 4 dm. or more high; leaves often 1 dm. long.

Leaves divided to near the base into linear-oblong or lanceolate narrow lobes. 7. *T. laciniata*.

Leaves sinuate or lobed half-way to the midrib or less; lobes triangular or ovate or broader.

Plant erect; leaves tapering at the base, acutely lobed. 8. *T. speciosa*.

Plant ascending or decumbent; leaves sinuately round-lobed, at least the upper cuneate or rounded at the base. 9. *T. sinuata*.

Petals straw-color.

Outer filaments dilated; petals 2-3 cm. long.

Petals about 2 cm. long; upper leaves with broad bases, long-acuminate. 10. *T. Rusbyi*.

Petals about 3 cm. long; none of the leaves broad at the base.

Plant branched below; flowers subtended by single entire bracts. 11. *T. nuda*.

Plants simple below; flowers subtended by several toothed bracts. 12. *T. stricta*.

Filaments all filiform; petals 4-5 cm. long. 13. *T. decapetala*.

1. *Touterea multicaulis* Osterhout. On plains of Colo.—Wolcott, Eagle Co.

2. *Touterea multiflora* (Nutt.) Rydb. (*Mentzelia multiflora* A. Gray) On dry plains from Colo. to Tex. and Ariz.; also Mex.—Alt. 7000-9000 ft.—Salida; Platte Cañon; Pine Grove; Artist Glen; Palmer Lake; Grayback mining camp and Placer Gulch.

3. *Touterea lutea* (Greene) Rydb. (*Mentzelia lutea* Greene) In dry soil in Colo.—Cañon City.

4. *Touterea chrysantha* (Engelm.) Rydb. (*M. chrysantha* Engelm.) On hills, mesas and cañons from Colo. and Utah to Ariz.—Cañon City.

5. *Touterea integra* (Jones) Rydb. (*Mentzelia multiflora integra* Jones) In arid soil of southern Utah and southwestern Colo.—Mesa across Gunnison from Grand Junction.

6. *Touterea densa* (Greene) Rydb. (*M. densa* Greene) In gulches and cañons and on dry table-land of Colo. and N. M.—Alt. 7000-9000 ft.—Cañon City; Salida; Gunnison; gulch west of Palmer Lake; Smith's Fork Cañon, Delta Co.; Hotchkiss.

7. *Touterea laciniata* Rydb. On plains and in cañons of Colo.—Alt. 5000-7000 ft.—Durango; Pagosa Springs; Cañon City; Antonito.

8. *Touterea speciosa* Osterh. (*Mentzelia speciosa* Osterh.) On hills and in dry valleys from Wyo. to Colo.—Alt. 5000-10,000 ft.—Estes Park, Larimer Co.; west of Loveland, Larimer Co.; Veta Pass; Idaho Springs; near Boulder; near Badito, between La Veta and Gardner; Turkey Creek and tributaries; Ute Pass; Dillon Cañon; Livermore; Arthur's Rock; Dixon Cañon; between Sunshine and Ward; Ft. Collins.

9. *Touterea sinuata* Rydb. In cañons of Colorado.—Boulder.

10. *Touterea Rusbyi* (Wootton) Rydb. (*Mentzelia Rusbyi* Wootton) On plains and in valleys from Wyo. to N. M. and Ariz.—Alt. 5000-7000 ft.—Wolcott; Glenwood Springs; Durango; Black Cañon; between Porter and Durango; Salida Cañon.

11. *Touitorea nuda* (Nutt.) Eat. & Wr. (*Mentzelia nuda* Nutt.) On plains and hillsides from western Neb. and Wyo. to Colo.—Alt. 4000-7000 ft.—Livermore, Larimer Co.; gulch west of Pennock's; Platte Cañon; valley of upper Arkansas River; Boulder.

12. *Touitorea stricta* Osterh. (*Hesperaster strictus* Osterh.) On plains, hillsides and dry valleys from western Neb. and Wyo. to Kans. and Tex.—Alt. 4000-7000 ft.—Colorado Springs; New Windsor, Weld Co.; Ft. Collins; near Manitou; Denver; Arboles; Pueblo; along the Poudre; Spring Cañon, Lyons; Boulder.

13. *Touitorea decapetala* (Pursh) Rydb. (*Bartonia decapetala* Pursh; *Mentzelia ornata* Pursh) In cañons from S. Dak. and Alb. to Tex. and Nev.—Alt. 4000-7000 ft.—Ft. Collins; west of Loveland; Huerfano Valley, near Gardner; near Boulder.

2. ACROLASIA.

Sepals lanceolate-subulate, half as long as the petals or longer, acute; seed rather strongly muriculate.

Leaves ovate in outline, entire or merely coarsely toothed. 1. *A. latifolia*.

Leaves lanceolate in outline; stem-leaves, except the uppermost, pinnately divided or lobed.

Petals 5-7 mm. long, about twice as long as the sepals.

Leaves divided to near the midrib with ascending lobes; plant erect.

2. *A. gracilis*.

Leaves divided $\frac{1}{2}$ - $\frac{2}{3}$ to the midrib, with divergent lobes; plant ascending or diffuse.

3. *A. ctenophora*.

Petals 2-4 mm. long.

4. *A. albicaulis*.

Sepals linear-oblong, obtusish, only $\frac{1}{2}$ as long as the petals, which are 3-4 mm. long; seeds minutely muriculate (tubercles seen only by very strong magnifications); leaves entire or dentate; the upper broadly ovate.

Tall, 3-5 dm. high; capsules 2-3 cm. long; lower leaves lanceolate or linear-lanceolate, some of them usually toothed.

5. *A. dispersa*.

Low, less than 2 dm. high; capsules 12-15 mm. long; leaves all ovate, entire.

6. *A. compacta*.

1. *Acrolasia latifolia* Rydb. On hillsides in Colo.—Alt. 6000-8000 ft.—Boulder; between Sunshine and Ward; Larimer County.

2. *Acrolasia gracilis* Rydb. (*Trachyphytum gracilis* Nutt.) In sandy soil from Wyo. and Ore. to Colo.—Alt. 5000-8000 ft.—Foot-hills, Larimer Co.; mesas near Pueblo; Salida; Tobe Miller's ranch.

3. *Acrolasia ctenophora* Rydb. On dry hills and on railroad banks in southern Colo.—Alt. 6000-7000 ft.—Walsenburg; Cucharas River below La Veta.

4. *Acrolasia albicaulis* (Dougl.) Rydb. (*Mentzelia albicaulis* Dougl.) On sandy soil from Neb., Mont. and B. C. to N. M. and Utah.—Alt. 4000-7000 ft.—Mesa, Gunnison River; Hotchkiss; Rist Cañon; near Boulder; Los Pinos; Mancos; Glenwood Springs; Sunset Cañon.

5. *Acrolasia integrifolia* (S. Wats.) Rydb. (*M. albicaulis integrifolia* S. Wats.; *M. dispersa* S. Wats.) In sandy soil from Mont. and B. C. to Colo. and Calif.—Alt. 6000-7000 ft.—Glenwood Springs, Garfield Co.; Horsetooth Gulch.

6. *Acrolasia compacta* (A. Nels.) Rydb. (*M. compacta* A. Nels.) In sandy soil in Wyo. and Colo.—Steamboat Springs.

3. MENTZELIA L.

1. *Mentzelia oligosperma* Nutt. On dry prairies, plains and hills from S. D. and Colo. to La. and Tex.; also in Mex.—Alt. 4000-6000 ft.—Foot-hills, Larimer Co.; southwest of Soldier Cañon.

Family 93. CACTACEAE H. B. K. CACTUS FAMILY.

Stems continuous or not conspicuously jointed; leaves obsolete; spines not barbed; spine-bearing and flower-bearing areolas distinct.

Flowers not arising from the tubercles, but from their axils; ovary naked.

1. CACTUS.

Flowers arising from the tubercles or ribs; ovary scaly.

Flowers nearly terminal, i. e., arising near the areolas which later develop spines; stem never jointed.

2. ECHINOCACTUS.

Flowers lateral, i. e., arising near the fully developed spine-bearing areolas.

3. ECHINOCEREUS.

Stems conspicuously jointed; leaves evident, but deciduous; spines barbed; flowers arising from spine-bearing areolas.

4. OPUNTIA.

1. CACTUS L. BALL-CACTUS.

Central spine usually solitary; corolla greenish.

Plant simple or nearly so; central spine robust, porrect. 1. *C. missouriensis*.

Plant caespitose; central spine often lacking.

2. *C. similis*.

Central spines 3-12; petals purple.

Plant usually caespitose, depressed-globose; central spines 3-4.

3. *C. viviparus*.

Plant usually simple, ovate to cylindric; central spines 4-12 (rarely 3).

4. *C. radiosus*.

1. *Cactus missouriensis* (Sweet) Kuntze. (*Mamillaria missouriensis* Sweet) On dry plains and hills from S. D. and Mont. to Kans. and Colo.—Como.

2. *Cactus similis* (Engelm.) Rydb. (*Mamillaria similis* Engelm.; *M. missouriensis caespitosa* S. Wats.) On dry hills from Kans. and Colo. to Tex.—"Colorado" (Greene).

3. *Cactus viviparus* Nutt. (*Mamillaria vivipara* Haw.) On dry hills and plains from Neb. and Mont. to Colo.—Ft. Collins.

4. *Cactus radiosus* (Engelm.) Coulter. On plains from Colo. and Utah to Tex. and Ariz. In Colorado it is only represented by the var. *neomexicanus* (Engelm.) Coulter, lower than the type and with more numerous central spines.—"Colorado"; Ft. Collins; Hermosa.

2. ECHINOCACTUS Link & Otto. HEDGEHOG-THISTLE, CACTUS.

Stems with tubercles, resembling *Cactus* in habit.

Radiating spines 8-9; central ones 1-3.

1. *E. glaucus*.

Radiating spines about 20; central ones 8-10.

2. *E. Simpsoni*.

Stems with definite ridges, scarcely tubercled.

3. *E. Whipplei*.

1. *Echinocactus glaucus* K. Sch. In dry places in Colo.—Alt. about 6000 ft.—Mesa Grande on Dry Creek; Gunnison.

2. *Echinocactus Simpsoni* Engelm. (*Mamillaria Simpsoni* M. E. Jones; *M. Purpusi* K. Sch.) On dry table-lands of Utah and Colo.—Alt. 7500-11,000 ft.—Clear Creek, Sangre de Cristo Pass; Veta Pass; Veta Mountain; Empire; Dolores.

3. *Echinocactus Whipplei* Engelm. & Big. On dry plains from Colo. and Utah to N. M. and Ariz. In Colorado has only been found the var. *spinosior* Engelm. with more numerous, 9-11, radiating spines.—La Plata Valley; Mesa Verde.

3. ECHINOCEREUS Engelm. CEREUS.

Ribs about 13; corolla greenish or yellowish.

1. *E. viridiflorus*.

Ribs 5-12; corolla red or purple.

Plant light green; corolla violet-purple; central spine 1, terete, nearly black, curved above.

2. *E. Fendleri*.

Plant dark green; corolla scarlet (except perhaps in the first).

Ribs 5-7.

Central spine 0; radiating ones 3-5, almost terete.

3. *E. paucispinus*.

Central spine 8 cm. long, angled and grooved; radiating ones 6-8, strongly angled.

4. *E. gonacanthus*.

Ribs 9-11.

Central spines all terete; flowers 4-6 cm. long, usually yellowish inside.

5. *E. aggregatus*.

Lower central spines quadrangular; flowers 8-10 cm. long.

6. *E. Roemerii*.

1. *Echinocereus viridiflorus* Engelm. (*Cereus viridiflorus* Engelm.) On high plains and hills from Wyo. to Tex. and N. M.—Alt. 5000-8000 ft.—Tobe Miller's ranch; Veta Mountain; Manitou; Colorado Springs; near Boulder.

2. *Echinocereus Fendleri* (Engelm.) Rümpl. (*Cereus Fendleri* Engelm.) On dry plains from Colo. and Utah to Tex. and Ariz.—"So. Colorado."

3. *Echinocereus paucispinus* (Engelm.) Rümpl. (*Cereus paucispinus* Engelm.) On rocks and limestone hills from Tex. to Colo.—Durango.

4. *Echinocereus gonacanthus* (Engelm. & Big.) Lehm. (*Cereus gonacanthus* Engelm. & Big.) On sandy bluffs in Colo. and N. M.—Florence; Arboles.

5. *Echinocereus aggregatus* (Engelm.) Rydb. (*Mamillaria aggregata* Engelm.; *Cereus phoeniceus* Engelm.) On plains and hillsides from Colo. to Tex. and Ariz.; also in Mex.—Alt. 5000-7500 ft.—La Veta; Badito.

6. *Echinocereus Roemerii* (Muhlenf.) Rydb. (*Cereus Roemerii* Muhlenf.; *C. conoideus* Big.) On plains from Colo. (?) to N. M. and Calif.—"So. Colorado."

4. OPUNTIA Mill. PRICKLY PEAR.

Internodes of stem short, more or less flattened.

Internodes of the stem oval or orbicular, decidedly flattened.

Fruit fleshy and juicy, spineless or nearly so.

Spines none, or a solitary strong one reflexed and 1-2 small ones at its base, all white or gray.

1. *O. mesacantha*.

Spines 1-8, not very unlike in length.

Spines not twisted.

Spines 1-3, brownish; internodes orbicular or obovate, 11-15 cm. wide.

2. *O. camanricha*.

Spines 5-7, white or gray; internodes oblong, 5 cm. long and 3.5 cm. wide.

3. *O. Schweriniana*.

Spines twisted, 3-5, white; internodes 13-17 cm. long and about as wide.

4. *O. tortispina*.

Fruit dry and usually with spine-bearing areolas.

Corolla yellow.

5. *O. polyacantha*.

Corolla red.

- Filament red; fruit very prickly. 6. *O. rhodantha*.
 Filaments yellow; fruit scarcely prickly. 7. *O. xanthostemma*.
 Internodes oblong or nearly cylindrical, turgid and nearly terete, easily breaking off, 2-4 cm. long. 8. *O. fragilis*.
 Internodes of stem elongated, cylindric or prismatic.
 Tubercles of the stem sharp and comb-like; erect shrub. 9. *O. arborescens*.
 Tubercles neither prominent nor comb-like; plant decumbent. 10. *O. Davisii*.

1. *Opuntia mesacantha* Raf. (*O. Rafinesqui* Engelm.) On plains and prairies especially in sandy soil from Wisc. and Minn. to Ky. and Ariz.—Alt. 4000-5500 ft.—Fort Collins; Denver; Boulder.
2. *Opuntia camanchica* Engelm. On plains from Colo. to Tex. and Ariz.—Alt. up to 6000 ft.—Colorado Springs.
3. *Opuntia Schweriniana* K. Sch. In dry places in Colo.—Sapinero.
4. *Opuntia tortispina* Engelm. On plains from Neb. and Colo. to Ind. Terr.—Exact locality not given.
5. *Opuntia polyacantha* Haw. (*O. missouriensis* DC.) On plains and hills from N. D. and B. C. to Ind. Terr., N. M. and Ore.—Alt. 4000-7000 ft.—Quimby; Ft. Collins; Denver; Walsenburg; North Cheyenne Cañon.
6. *Opuntia rhodantha* K. Sch. On plains of Neb. and Colo.—Alt. 4000-8000 ft.—“Colorado”; Grand Junction; Boulder.
7. *Opuntia xanthostemma* K. Sch. On plains of western Colo.—Mesa Grande.
8. *Opuntia fragilis* Haw. On prairies and plains from Wisc. and B. C. to Kans. and Colo.—Denver; Boulder.
9. *Opuntia arborescens* Engelm. On plains and hills from Colo. to Tex. and Ariz.—Alt. 4000-6000 ft.—Pueblo; Piedra.
10. *Opuntia Davisii* Engelm. In dry soil from Colo. to Tex. and Calif.—La Plata Valley, Mancos and McElmo (*Brandegei*).

Order 36. THYMELIALES.

Family 94. ELAEAGNACEAE Lindl. OLEASTER FAMILY.

1. LEPARGYRAEA Raf. BUFFALO-BERRY.

- Leaves ovate or oval, green above; shrub thornless. 1. *L. canadensis*.
 Leaves oblong, silvery on both sides; shrub thorny. 2. *L. argentea*.

1. *Lepargyrea canadensis* (L.) Greene. (*Shepherdia canadensis* L.) In woods from Newf. and Alaska to N. Y., Colo. and Ore.—Alt. 6500-12,000 ft.—Villa Grove, Black Cañon; Georgetown; Bear Creek Divide, West La Plata Mountains; southeast of Ouray; Box Cañon, west of Ouray; Chambers' Lake; Graham's Park; mountains of Larimer Co.; Stove Prairie Hill; Bosworth's ranch; Eldora to Baltimore.

2. *Lepargyrea argentea* (Nutt.) Greene. (*Shepherdia argentea* Nutt.) On sandy river banks and islands from Man., Sask. and Alb. to Kans., N. M. and Nev.—Alt. 4000-7000 ft.—Grand Junction; Cimarron; Mancos; La Porte, Larimer Co.; Wolcott; Hotchkiss; Dolores; Durango.

Order 37. MYRTALES.

Styles present; mostly land-plants.

Hypanthium merely enclosing the ovary.

Hypanthium adnate to the ovary.

Styles wanting; stigma sessile; aquatics.

95. LYTHRACEAE.

96. EPILOBIACEAE.

97. GUNNERACEAE.

Family 95. **LYTHRACEAE** Lindl. LOOSESTRIFE FAMILY.

Hypanthium cylindric.

Hypanthium campanulate or hemispheric.

1. LYTHRUM.

2. AMMANIA.

1. **LYTHRUM** L. LOOSESTRIFE.

1. *Lythrum alatum* Pursh. In swamps from Mass. and S. D. to Ky. and Colo.—Alt. 5000–6000 ft.—Near Boulder.

2. **AMMANIA** L.

1. *Ammania coccinea* Rottb. In swampy places from Ind. to S. D., Fla. and Mex.; also S. Am.—Denver.

Family 96. **EPILOBIACEAE** DC. EVENING PRIMROSE FAMILY.

Flowers 4-merous.

Fruit a many-seeded capsule, opening by valves.

Seeds with a tuft of silky hairs.

Hypanthium not prolonged beyond the ovary; flowers large.

1. CHAMAENERION.

Hypanthium somewhat prolonged beyond the ovary; flowers small.

2. EPILOBIUM.

Seeds without a tuft of silky hairs, naked or tuberculate.

Hypanthium not produced beyond the ovary; flowers minute.

3. GAYOPHYTUM.

Hypanthium produced beyond the ovary into a long tube.

Stigma divided into 4 linear lobes.

Stamens equal in length; capsule terete or round-angled.

Ovules and seeds horizontal, inserted in 2 or rarely more rows, prismatic-angled; petals yellow.

4. ONAGRA.

Ovules and seeds ascending, in one row, not angled; buds drooping; petals white or pink.

5. ANOGRA.

Stamens unequal in length, the alternate longer; capsule crested or winged; plant acaulescent or low-stemmed.

Capsules with more or less distinct double crests on the angles; seed furrowed along the raphe.

6. PACHYLOPHUS.

Capsules winged or at least sharply angled on the angles.

Plants acaulescent, caespitose.

7. LAVAUXIA.

Plants caulescent with wiry diffuse stems.

8. GAURELLA.

Stigma discoid or capitate.

Stigma discoid; hypanthium-tube funnellform above.

Hypanthium-tube longer than the ovary; stigma entire.

9. GALPINSIA.

Hypanthium-tube shorter than the ovary; stigma 4-toothed.

10. MERIOLIX.

Stigma capitate.

Plant acaulescent; capsules 4-winged; hypanthium-tube tubular-cylindric.

11. TARAXIA.

Plant caulescent; capsules not winged; hypanthium-tube obconic or funnellform.

Capsule linear, sessile, narrowed above.

12. SPHAEROSTIGMA.

Capsule more or less clavate, pedicelled and obtuse.

13. CHYLISMA.

Fruit indehiscent, nut-like.

Hypanthium-tube filiform; filaments unappendaged; ovary 1-celled.

14. STENOSIPHON.

Hypanthium-tube obconic; filaments with scales at the base; ovary 4-celled.

15. GAURA.

Flowers 2-merous; fruit indehiscent, obovoid and bristly with hooked hairs.

16. CIRCAEA.

1. CHAMAENERION Adans. FIRE-WEED.

Style pubescent at the base; leaves lanceolate or linear-lanceolate with the lateral veins confluent in marginal loops.

1. *C. angustifolium*.

Style glabrous; leaves ovate or ovate-lanceolate; lateral veins obsolete, not looped.

2. *C. latifolium*.

1. *Chamaenerion angustifolium* (L.) Scop. (*Epilobium angustifolium* L.)

On hills, in open woods and copses, especially on burnt areas from Greenl. and Alaska to N. C., Ariz. and Calif.—Alt. 6000–10,000.—Caribou; foot-hills, Larimer Co.; Oro City; Estes Park, Larimer Co.; Pagosa Peak; near La Plata Post Office; La Plata Cañon; Marshall Pass; Cameron Pass; Pike's Peak; Red Mountain, south of Ouray; Jack's Cabin; Artist's Glen; Como; Larimie River at Sherwood's; Baxter's ranch; Bosworth's ranch, Stove Prairie; Boulder Cañon; mountains between Sunshine and Ward.

2. *Chamaenerion latifolium* (L.) Sweet. (*E. latifolium* L.) In wet ground from Greenl. and Alaska to Colo. and Wash.—Alt. 7500–10,000 ft.—Graymont; Ruby; Gunnison; near La Plata Post Office; La Plata Cañon; Clear Creek; Empire.

2. EPILOBIUM L. WILLOW-HERB.

Perennials; stigma entire or merely notched.

Leaves oblong, oval, ovate, or lanceolate, usually dentate or denticulate.

Plants with rosettes or turions; leaves ovate or lanceolate, usually broadest below the middle and distinctly denticulate or dentate.

Stem pubescent throughout.

1. *E. Palmeri*.

Stem glabrous except sometimes the upper portion and the decurrent lines.

Flowers 7–8 mm. long; petals purple or dark pink; leaves ovate-lanceolate.

Leaves sessile or nearly so; innovations by turions.

Seeds without apiculations; coma sessile.

2. *E. ovatifolium*.

Seeds with a pale hyaline beak at the apex.

3. *E. brevistylum*.

Leaves short-petioled; innovations by rosettes.

4. *E. occidentale*.

Flowers 3–5 mm. long.

Leaves all except the uppermost short-petioled.

5. *E. adenocaulon*.

Leaves all sessile or only the very earliest sometimes short-petioled.

Leaf-blades rounded at the base, broadly lanceolate to ovate.

Petals purple, 5–8 mm. long; leaf-blades usually ovate.

2. *E. ovatifolium*.

Petals white, 4 mm. long; leaves lanceolate.

6. *E. rubescens*.

Leaf-blades acute at the base.

Leaf-blades ample, ovate or broadly lanceolate.

7. *E. stramineum*.

Leaf-blades narrow lanceolate, almost erect; plant slender, 1–3 dm. high.

8. *E. Drummondii*.

Plants with stolons or soboles, low, 1–2 (seldom 3) dm. high.

Petals white; plant 1-3 dm. high, stoloniferous. 9. *E. alpinum*.

Petals purple or pink.

Plant 1-3 dm. high, soboliferous; flowers 5-7 mm. long.

10. *E. Hornemannii*.

Plant usually less than 1 dm. high, stoloniferous; flowers less than 5 mm. long.

Flowers nodding in bud; pod cylindrical; seeds smooth.

11. *E. anagallifolium*.

Flowers ascending in bud; pod somewhat clavate; seeds papillose.

12. *E. clavatum*.

Leaves narrowly linear, entire; innovations of long subterranean shoots, bearing at their ends ovoid turions; petals white; capsule cinereous.

Leaves and lower part of the stem glabrous.

13. *E. wyomingense*.

Leaves and stem crisp-pubescent.

14. *E. lineare*.

Annuals with more or less sheddy, straw-colored bark; stigma 4-cleft.

Pedicels and pods sparingly glandular, the former long.

15. *E. paniculatum*.

Whole inflorescence densely glandular; pedicels very short, scarcely exceeding the bracts.

16. *E. adenocladon*.

1. *Epilobium Palmeri* Rydb. In wet places from Mont. and Ida. to Utah and Colo.—Tobe Miller's ranch.

2. *Epilobium ovatifolium* Rydb. In wet ground in Colo. and Utah.—Alt. 8000-13,000 ft.—Lake City; head of Bard Creek; mountains above Ouray; Bob Creek, west of Mt. Hesperus; headwaters of Sangre de Cristo Creek; near Pagosa Peak; Red Mountain, south of Ouray; Iron-ton Park, 9 miles south of Ouray; Columbine; west of Ouray; Grayback mining camps and Placer Gulch.

3. *Epilobium brevistylum* Haussk. Along streams from Mont. and Wash. to Colo. and Calif.—Alt. 8000-9000 ft.—Veta Pass; headwaters of Pass Creek; near Pagosa Peak; north of Steamboat Springs.

4. *Epilobium occidentale* (Trelease) Rydb. (*E. adenocaulon occidentale* Trelease) In wet ground from Mont. and Alb. to S. D. and Colo.—Alt. 5000-10,000 ft.—Caribou; Boulder; Van Boxle's ranch above Cimarron.

5. *Epilobium adenocaulon* Haussk. (*E. coloratum* Torr.; not Muhl.) In swamps and wet meadows from N. B. and Wash. to Pa., Colo. and Nev.—Alt. 4000-10,000 ft.—Cheyenne Mountain; near Empire; Pagosa Springs; Mountain View; Engelmann Cañon; William's Cañon; Parlin, Gunnison Co.; North Cheyenne Cañon; Spring Cañon; foot-hills, Larimer Co.; South Park; Ft. Collins; Grizzly Creek; Dark Cañon, Pike's Peak; Durango; South Park; Boulder.

6. *Epilobium rubescens* Rydb. In wet places of Colo.—Alt. up to 9000 ft.—Pagosa Springs; Middle Park; Engelmann Cañon.

7. *Epilobium stramineum* Rydb. In wet places of Colo. and Wyo.—Alt. 8000-11,000 ft.—Sangre de Cristo Creek; Chicken Creek, West La Plata Mountains; Bob Creek, west of Mt. Hesperus; Idaho Springs; near Pagosa Peak; Ruxton.

8. *Epilobium Drummondii* Haussk. Along brooks from Sask. and Wash. to S. D. and Colo.—Alt. 8000-9000 ft.—Headwaters of Clear Creek; South Park; Van Boxle's ranch, above Cimarron; Sargent's; headwaters of Sangre de Cristo Creek; Walton Creek, Routt Co.; summit of North Park Range, Larimer Co.

9. *Epilobium alpinum* L. On mountain sides in wet places from Greenl. and Alaska to N. H., Colo. and Calif.—Alt. 9000-11,000 ft.—Head of Bard

Creek; mountains above Ouray; Cameron Pass; Front Range, Larimer Co.; Gore Pass; Chambers' Lake; Graymont.

10. *Epilobium Hornemannii* Reichenb. On mountain sides in wet places, from Greenl. and Alaska to N. H., Colo. and Calif.—Alt. 8000–10,000 ft.—Near Empire; Mt. Harvard; head of Bard Creek; Marshall Pass; Cameron Pass; Grayback mining camps and Placer Gulch; Estes Park, Larimer Co.; Silver Plume; Beaver Creek; Buffalo Pass; summit of North Park Range, Larimer Co.

11. *Epilobium anagallifolium* Lam. In wet soil from Lab. and Alaska to Colo. and Nev.—Alt. 10,000–12,000 ft.—Caribou; near Pagosa Peak; Silver Plume; west of North Park.

12. *Epilobium clavatum* Trelease. On alpine peaks from Mont. and B. C. to Colo.—Summit of North Park Range, Larimer Co.

13. *Epilobium wyomingense* A. Nels. (*E. palustris albiflorum* Hook.) In swamps from Sask. and Yukon to Colo.

14. *Epilobium lineare* Muhl. In swamps from N. B. and B. C. to Del., Ind. Terr. and Colo.—New Windsor.

15. *Epilobium paniculatum* Nutt. In sandy soil from Alb. and B. C. to Colo. and Calif.—Alt. 5000–9000 ft.—Gregory Cañon; headwaters of Clear Creek; Ft. Collins; Doyle's; Marshall Pass; south of Ouray; Cimarron; Ruxton Park; Piedra; mountains, Larimer Co.; Horsetooth Gulch; between Porter and Durango; Gunnison Co.; gulch west of Soldier Cañon; Steamboat Springs; Boulder; Elk River, Routt Co.

16. *Epilobium adenocladon* (Haussk.) Rydb. (*E. paniculatum adenocladon* Haussk.) In sandy soil from S. D. and Wyo. to Colo. and Utah.—Alt. 5000–8500 ft.—Boulder; southeast of Ouray; Horsetooth Gulch; Soldier Cañon; Cassel's.

3. *GAYOPHYTUM* Juss.

Capsules torulose, less than 3 times as long as the stipes, usually more or less clavate.

Petals 1.5–2.5 mm. long, rose with yellow base; capsules 8–12 mm. long, nearly twice as long as the stipes. 1. *G. intermedium*.

Petals about 1 mm. long, rose or white.

Capsules decidedly clavate, rounded at the apex, seldom longer than the stipes, spreading or reflexed. 2. *G. ramosissimum*.

Capsules only slightly if at all clavate, narrow, usually longer than the stipes and erect. 3. *G. Nuttallii*.

Capsules neither torulose nor clavate; stipes very short. 4. *G. racemosum*.

1. *Gayophytum intermedium* Rydb. On hillsides in sandy soil from Mont. and Wash. to Colo. and Calif.—Alt. 5000–10,000 ft.—Caribou; near Empire; west of Ouray; Chambers' Lake; Grayback mining camps and Placer Gulch; Veta Pass; Ward, Boulder Co.; between Sunshine and Ward; Boulder; North Park; Table Rock.

2. *Gayophytum ramosissimum* T. & G. On hillsides, especially in sandy soil, from Mont. and Wash. to Colo., Ariz. and Calif.—Alt. 6000–10,000 ft.—Headwaters of Clear Creek; Lake City; Grayback mining camps and Placer Gulch; Mt. Harvard; Veta Pass; Turkey Creek and tributaries; Pagosa Springs; Calhan; Rabbit-Ear Pass; Los Pinos; Black Cañon; La Veta; Dillon; Valley Spur; west of Ouray; Baxter's ranch; Chambers' Lake; Walton Creek; Table Rock; Dolores; gulch west of Soldier Cañon.

3. *Gayophytum Nuttallii* T. & G. On hillsides from S. D. and Wash. to Colo., Ariz. and Calif.—Alt. 6000–8000 ft.—Parlin, Gunnison Co.; foot-hills, Larimer Co.

4. *Gayophytum racemosum* T. & G. In sandy soil from Wyo. and Wash. to Colo. and Calif.—Alt. 5000–12,000 ft.—Headwaters of Clear Creek; Veta Pass; above Mancos; along the Poudre.

4. ONAGRA Adans. EVENING PRIMROSE.

Hypanthium slender, 2.5–5 cm. long.

Petals 1–2 cm. long, yellow; pubescence rarely hirsute.

Plant green; capsule 3–4 cm. long.

1. *O. Oakesiana*.

Plant grayish strigose; capsule 2–3 cm. long.

2. *O. strigosa*.

Petals 2–3.5 cm. long, often pinkish; plant more or less hirsute.

3. *O. Hookeri*.

4. *O. Jamesii*.

Hypanthium stout, 6–13 cm. long.

1. *Onagra Oakesiana* (A. Gray) Britton. (*Oenothera Oakesiana* A. Gray) In rich valleys from Que. and S. D. to N. Y. and Colo.—Alt. up to 10,000 ft.—Salida; North Cheyenne Cañon; Valley Spur.

2. *Onagra strigosa* Rydb. In valleys and on plains from Minn. and Wash. to Kans., N. M. and Utah.—Alt. 4000–7000 ft.—Ft. Collins; Colorado Springs; Gunnison; Elk River, Routt Co.; Engelmann Cañon; Poudre Cañon; Gypsum; soldier Cañon.

3. *Onagra Hookeri* (T. & G.) Small. (*Oenothera Hookeri* T. & G.; *O. biennis hirsutissima* A. Gray) In valleys from Ida. to N. M. and Calif.; also Mex.—Alt. 6000–10,000 ft.—Black Cañon of Gunnison; Cañon City, Fremont Co.; Pagosa Springs; Parrott Post Office; west of Ouray; Wahatoya Creek; Pike's Peak; Durango; along Conejos River north of Antonito.

4. *Onagra Jamesii* (T. & G.) Small. (*Oenothera Jamesii* T. & G.) In dry soil from Okl. and Utah to Tex. and Ariz.—On Platte River (?).

5. ANOGRA Spach. WHITE EVENING PRIMROSE.

Calyx in bud merely acutish; tips not free.

Capsule divergent or reflexed.

1. *A. violacea*.

Capsule erect or ascending.

2. *A. albicaulis*.

Calyx in bud acuminate or acute; tips free.

Capsule linear-cylindric; throat of the calyx glabrous.

Calyx sparingly long-hairy, glandular-puberulent or glabrous, not strigose.

Leaves deeply pinnatifid.

3. *A. rhizomata*.

Leaves subentire, dentate or short-lobed.

Capsules strongly ascending, straight; leaves linear, entire or nearly so, strigose beneath.

4. *A. Nuttallii*.

Capsules divergent, usually curved upwards; leaves usually denticulate or sometimes lobed.

Leaves glabrous, except the margins.

5. *A. Vreelandii*.

Leaves pubescent on both sides.

6. *A. cinerea*.

Calyx and hypanthium densely grayish strigose; leaves cinerous.

7. *A. latifolia*.

Capsules oblong; throat of the calyx hairy; leaves deeply pinnatifid.

8. *A. coronopifolia*.

1. *Anogra violacea* A. Nels. In sandy soil of Wyo. and Colo.—Alt. 4000–5500 ft.—Deer River; Palisades; Hotchkiss.

2. *Anogra albicaulis* (Pursh) Britton. (*Oenothera pinnatifida* Nutt.) On hillsides from N. D. and Mont. to Tex. and Sonora.—Alt. 4000-7000 ft.—Denver; Ft. Collins; Rist Cañon; river-bluffs north of La Veta; Cucharas Valley near La Veta; Larimer Co.; McElmo Cañon; Purgatory River, Trinidad; Horsetooth Gulch; Palisades; Grand Junction, mesa across Gunnison River; Boulder; Ft. Collins.

3. *Anogra rhizomata* A. Nels. In sandy soil in Wyo. and Colo.—Alt. about 7500 ft.—Gunnison.

4. *Anogra Nuttallii* (Lindl.) A. Nels. (*O. Nuttallii* Lindl.) In sandy soil from Minn. and Ida. to Colo.—Alt. 4000-9000 ft.—Denver; La Porte; Fossil Creek, Larimer Co.; Grizzly Creek; Manitou; Table Rock; Baxter's ranch; Colorado Springs; Boulder; Buena Vista; Ivywild.

5. *Anogra Vreelandii* Rydb. In cañons of Colo.—Alt. about 6000 ft.—McElmo Cañon.

6. *Anogra cinerea* Rydb. In dry soil from western Neb. and Wyo. to Colo.—Denver; between Bent's Fort and Pueblo.

7. *Anogra latifolia* Rydb. (*Oenothera pallida latifolia* Rydb.) On sandy soil from Neb. to Colo. and Kans.—Alt. 4000-10,000 ft.—Gunnison; Marshall Pass; Sterling, Logan Co.

8. *Anogra coronopifolia* (T. & G.) Britton. On prairies and plains from S. D. and Wyo. to Kans. and N. M.—Alt. 4000-9000 ft.—Cheyenne Mountain; Moon's ranch, Larimer Co.; plains west of Ft. Collins; Denver; Clear Creek Station; along the Platte; Pike's Peak; Idaho Springs; Piedra; Mancos; Cucharas River below La Veta; Gunnison; Manitou; Buena Vista; Palmer Lake; Grayback mining camps and Placer Gulch; North Park; Spring Cañon; Baxter's ranch; road to Soldier Cañon; vicinity of Pine Grove; Estes Park; Boulder; Como; Hayden.

6. PACHYLOPHUS Spach.

Plant glabrous.

1. *P. caespitosus*.

Plant more or less hairy.

Hypanthium, calyx and fruit glabrous, slightly strigose or with a few scattered long hairs.

Tube of the hypanthium 3-6 cm. long; pubescence (except on the margins of the leaves) short and usually appressed.

2. *P. montanus*.

Tube of hypanthium 6-12 mm. long.

Plant acaulescent, caespitose; pod short conic-ovoid, with very thick ridges.

3. *P. macroglottis*.

Plant more or less caulescent; pod elongated conic-ovoid, with low ridges.

4. *P. caulescens*.

Hypanthium, calyx and fruit densely hirsute.

Pod stipitate.

5. *P. marginatus*.

Pod sessile.

Plant acaulescent; ridges of the fruit slightly tuberculate.

6. *P. hirsutus*.

Plant more or less caulescent; ridges of the fruit with lobed, more or less foliaceous crests.

7. *P. exiguus*.

1. *Pachylophus caespitosus* (Nutt.) Raim. (*Oenothera caespitosa* Nutt.) On dry hills from N. D. and Wyo. to Colo. and Utah.—Alt. 4000-9000 ft.—Grizzly Creek; foot of Horsetooth Mountain.

2. *Pachylophus montanus* (Nutt.) A. Nels. (*Oenothera montana* Nutt.) On dry hills from Ass. and Ida. to Colo. and Nev.—Alt. up to 7500 ft.—Mancos; Palisade; mesa across Gunnison River from Grand Junction; Elk Cañon; Dillon Cañon, Trinidad.

3. *Pachylophus macroglottis* Rydb. On hillsides in Colo.—Alt. 5000-10,000 ft.—Red Rock Cañon; Turkey Creek and tributaries; foot-hills, Larimer Co.; Horsetooth Gulch; gulch west of Pennock's; Narrows, Poudre Cañon; Pennock's mountain ranch; Dolores; Manitou; Hotchkiss; Pike's Peak; butte, 5 miles southwest of La Veta; Cerro Summit; Arboles; Boulder.

4. *Pachylophus caulescens* Rydb. On hillsides and river banks in Colo.—Alt. 4500-9000 ft.—Palisade, bank of Grand River; Dolores.

5. *Pachylophus marginatus* (Nutt.) Rydb. (*Oenothera marginata* Nutt.; *O. idahoensis* Mulford) On hills from Ida. and Ore. to Utah and Colo.—Glenwood Springs.

6. *Pachylophus hirsutus* Rydb. On hillsides from Wyo. to N. M. and Utah.—Alt. 7000-10,000 ft.—Empire; above Como, South Park; Pennock's mountain ranch; Georgetown; South Park; Ruxton; near Mancos; Pike's Peak; mountains between Sunshine and Ward.

7. *Pachylophus exiguus* (A. Gray) Rydb. (*Oenothera exigua* A. Gray) On plains from Colo. to N. Mex.—Alt. 4000-5500 ft.—Rocky Ford, bank of Arkansas River; mesas near Pueblo; Garden of the Gods.

7. LAVAUXIA Spach.

Leaves strigose-canescens.

1. *L. brachycarpa*.

Leaves green, glabrous or puberulent with ciliate margins.

2. *L. flava*.

1. *Lavauxia brachycarpa* (A. Gray) Britton. (*Oenothera brachycarpa* A. Gray) On plains from Kans. and Colo. to Tex. and N. M.—Alt. 4000-6000 ft.—Loveland; Denver; west of Ft. Collins; Ft. Collins; Fossil Creek; north of La Porte; Tobe Miller's ranch; Boulder.

2. *Lavauxia flava* A. Nels. (*Oenothera triloba* S. Wats., in part; not Nutt.) In valleys from Ass. and Ore. to Colo. and Calif.—Alt. 5000-10,000 ft.—Leadville; North Park; Arboles; Egeria Park; headwaters of Sangre de Cristo Creek; Grayback mining camps and Placer Gulch; near Parrott Post Office; Rabbit-Ear Range; Table Rock; Leroux Creek; Steamboat Springs; north of La Porte; Alamosa.

8. GAURELLA Small.

1. *Gaurella guttata* (Geyer) Small. (*Oenothera canescens* Torr.) On dry plains from Neb. and Colo. to Okl. and N. Mex.—Purgatory River.

9. GALPINSIA Britton.

1. *Galpinsia lavandulaefolia* (T. & G.) Small. (*Oenothera lavandulaefolia* T. & G.) On plains and prairies from Neb. and Wyo. to Tex. and Mex.—Alt. 4000-5500 ft.—Mesas near Pueblo; Grand Junction.

10. **MERIOLIX** Raf.

Throat of the hypanthium dark-purple within.

1. *M. melanoglottis*.

Throat of the hypanthium orange within, sometimes with a darker ring at the base of the stamens.

2. *M. serrulata*.

1. *Meriolix melanoglottis* Rydb. On plains from Tex. to Colo.—“Colo.,” exact locality not given.

2. *Meriolix serrulata* (Nutt.) Walp. (*Oenothera serrulata* Nutt.) On plains and hills from Man. and Sask. to Colo. and Ariz.—Alt. 4000-8000 ft.—Boulder; Denver; first range of foot-hills, Larimer Co.; Ft. Collins; Palmer Lake; Ouray; Monument; Manitou Junction; Pennock's mountain ranch.

11. **Taraxia** Nutt.

Leaves linear, silky-hirsute.

1. *T. graciliflora*.

Leaves oblanceolate, glabrous.

2. *T. subacaulis*.

1. *Taraxia graciliflora* (H. & A.) Raim. Hillsides in California. One specimen collected by Fremont is labeled “Arkansas River, above Pueblo.” This may have been a mistake in labeling, as the species is not known east of the Great Basin.

2. *Taraxia subacaulis* (Pursh) Rydb. (*Jussiaea subacaulis* Pursh; *Oenothera heterantha* Nutt.) In valleys from Mont. and Ida. to Colo. and Calif.—Steamboat Springs.

12. **SPHAEROSTIGMA** Nutt.

Corolla yellow, turning reddish or greenish; plant hirsutulous below; often glandular above.

1. *S. pubens*.

Corolla white or rose-color; plant stigulose or puberulent.

2. *S. minutiflorum*.

1. *Sphaerostigma pubens* (S. Wats.) Rydb. (*Oenothera strigulosa pubens* S. Wats.) In sandy soil from Ida. and B. C. to Colo. and Calif.—Arkansas River above Pueblo.

2. *Sphaerostigma minutiflora* (S. Wats.) Rydb. (*Oenothera allysoides minutiflora* S. Wats.) In sandy soil from Wyo. to Colo. and Nev.—Grand Junction.

13. **CHYLISMA** Nutt.

1. *Chylisma scapoidea* (Nutt.) Small. (*Oenothera scapoidea* Nutt.) In arid soil from Wyo. to Colo. and Utah.—Alt. 4500-7000 ft.—Palisade, bank of Grand River; Cimarron; Grand Junction; Hotchkiss; Cañon City.

14. **STENOSIPHON** Spach.

1. *Stenosiphon linifolium* (Nutt.) Britton. (*S. virgatus* Spach.) On prairies from Neb. and Colo. to Ark., Tex. and Mex.—Exact locality not given.

15. **GAURA** L.

Anthers oval, attached near the middle; fruit fusiform, sessile, almost equally 8-ribbed.

1. *G. parviflora*.

Anthers linear or nearly so, attached near the base; fruit strongly 4-angled, at least above.

Fruit sessile, broadly fusiform; tall biennials.

2. *G. neo-mexicana*.

Fruit prolonged below into a stipe-like base.

Stipe-like base slender; fruit fusiform; tall herbaceous plants.

3. *G. coloradensis*.

Stipe-like base thick; body of the fruit pyramidal-ovoid; low plants with subligneous base.

Plants more or less pubescent.

Stem hirsute as well as strigose, at least below.

4. *G. coccinea*.

Stem merely strigose or glabrous below.

Leaves canescent, the lower usually oblong and sinuately toothed.

5. *G. marginata*.

Leaves sparingly strigose; all linear and entire.

6. *G. parvifolia*.

Plant glabrous or nearly so, except the strigose hypanthium.

7. *G. glabra*.

1. *Gaura parviflora* Dougl. In valleys from S. D. and Wash. to La. and Ariz.; also Sonora.—Alt. 4000–7000 ft.—Colorado Springs; Cucharas Valley, near La Veta; Durango; Ft. Collins; William's Cañon; Deer River; along the Platte River; Boulder.

2. *Gaura neo-mexicana* Wooton. In valleys of Colo. and N. M.—Alt. about 7000 ft.—Pagosa Springs; Piedra.

3. *Gaura coloradensis* Rydb. On hills of Colo.—Alt. about 5000 ft.—Ft. Collins; east of Poudre and east of College.

4. *Gaura coccinea* Nutt. On plains and prairies from Mont. to Tex. and Ariz.—Alt. 4000–5500 ft.—Denver; Pike's Peak; New Windsor, Weld Co.; mesas near Pueblo; Ead's; Ft. Collins; Quimby; Ouray; Platte River.

5. *Gaura marginata* Lehm. On plains and prairies from Man., Sask. and Mont. to Kans. and Colo.—Alt. 4000–6000 ft.—Ft. Collins; Walsenburg.

6. *Gaura parvifolia* Torr. On dry plains of Colo. and N. M.—Alt. 4000–7000 ft.—Durango; Pueblo; Colorado Springs; Ft. Collins.

7. *Gaura glabra* Lehm. On plains from S. D. and Mont. to Colo. and Ariz.—Alt. 4000–8000 ft.—Trail Glen; Gunnison; Ft. Collins; Durango; Boulder.

16. CIRCAEA L. ENCHANTER'S NIGHTSHADE.

Plant 1–2 dm. high; leaves sharply dentate, usually cordate at the base

1. *C. alpina*.

Plant 3–6 dm. high; leaf-blades sinuately denticulate, usually truncate or rounded at the base.

2. *C. pacifica*.

1. *Circaea alpina* L. (*C. pacifica* Coulter; not Aschers. and Magn.) In moist woods from Lab. and Alaska to Ga. and Colo.—Alt. 7000–8000 ft.—Green Mountain Falls; Estes Park, Larimer Co.; foot-hills, Larimer Co.; gulch, Soldier Cañon; vicinity of Pine Grove; Stove Prairie Hill; Rist Cañon; Bosworth's ranch, Stove Prairie.

2. *Circaea pacifica* Ach. & Magn. In wet woods from Mont. and Wash. to Colo. and Calif.—Locality not given; probably doubtful.

Family 97. GUNNERACEAE Endl. WATER MILFOIL FAMILY.

Stamen 1; ovary 1-celled; leaves entire.

1. *HIPPURUS*.

Stamens 4–8; ovary 4-celled, splitting into 4 nutlets; at least the submerged leaves pinnatifid.

2. *MYRIOPHYLLUM*.

1. **HIPPURUS** L. MARE'S-TAIL, BOTTLE-BRUSH.

1. *Hippurus vulgaris* L. In water from Greenl. and Alaska to Mich., N. M. and Calif.—Alt. 7000–10,000 ft.—Iron-ton Park, 9 miles south of Ouray; Gunnison; Laramie River near Colorado line; Wahatoya Creek; Hamor's Lake above Durango; Hotchkiss.

2. **MYRIOPHYLLUM** L. WATER-MILFOIL.

1. *Myriophyllum spicatum* L. In water from Newf., Sask. and Ida. to Fla. and Calif.—Alt. up to 8000 ft.—Gunnison.

Order 38. **UMBELLALES.**

Fruit drupaceous or baccate; gynoecium 1–several-carpellary; if 2-carpellary, stigmas introrse.

Ovule with a ventral raphe; leaves mostly alternate; blades lobed or compound.

98. **HEDERACEAE.**

Ovule with a dorsal raphe; leaves mostly opposite; blades entire or merely toothed.

99. **CORNACEAE.**

Fruit dry, a cremocarp; gynoecium 2-carpellary; stigmas terminal.

100. **AMMIACEAE.**

Family 98. **HEDERACEAE** L. IVY FAMILY.1. **ARALIA** L. WILD SARSAPARILLA.

1. *Aralia nudicaulis* L. In woods from Newf. and Ida. to N. C., Mo. and Colo.—Alt. 5000–9000 ft.—Mountains of Estes Park, Larimer Co.; mountains, Larimer Co.; north of Cheyenne Cañon; Engelmann's Cañon; Colorado Springs; Jack Brook; Boulder.

Family 99. **CORNACEAE** Link. DOGWOOD FAMILY.

Flowers in open cymes, not subtended by an involucre; shrubs. 1. **SVIDA.**

Flowers in a head or umbel subtended by a large white involucre; herbs.

2. **CORNELLA.**

1. **SVIDA** Opis. DOG-WOOD, CORNEL.

Young branches and inflorescence villous.

1. *S. interior.*

Young branches appressed strigose or nearly glabrous.

2. *S. stolonifera riparia.*

1. *Svida interior* Rydb. On river banks in Neb., S. D., Wyo. and Colo.—Alt. 4000–6000 ft.—Colorado Springs; Cañon City; Meeker; Walsenburg; gulch west of Pennock's.

2. *Svida stolonifera riparia* Rydb. On river banks from Man., Mackenzie and Alaska to Neb., Colo. and Ariz.—Alt. 4000–10,000 ft.—Lake City; Ouray; 6 miles below Hot Sulphur Springs; Walsenburg; Minnehaha; Upper La Plata Cañon; Box Cañon, west of Ouray; Pass Creek; Ft. Collins; Crystal Creek; Redstone; Gunnison; Mancos; Turkey Creek and tributaries; Parlin, Gunnison Co.; gulch south of Rist Cañon; Bosworth's ranch; near Narrows of Cache la Poudre; gulch west of Pennock's; Stove Prairie.

2. **CORNELLA** Rydb. BUNCH-BERRY, DWARF CORNEL.

1. *Cornella canadensis* (L.) Rydb. (*Cornus canadensis* L.) In woods from Lab. and Alaska to N. J., Minn., Colo. and Calif.—North Park.

Family 100. **AMMIACEAE** Presl. **CARROT FAMILY.**

Fruit bristly or spiny.

Fruit subglobose, covered with hooked spines; leaves palmately divided.

1. **SANICULA.**

Fruit linear or linear-oblong, attenuate at the base, bristly on the angles; leaves twice to thrice ternate.

2. **WASHINGTONIA.**

Fruit neither spiny nor bristly.

Fruit not strongly flattened dorsally, usually more or less laterally flattened.

Oil-tubes obsolete in the mature fruit, which is linear; leaves twice or thrice ternate.

3. **GLYCOSMA.**

Oil-tubes present.

Oil-tubes solitary in the intervals; petals white.

Stylopodium conical.

Divisions of the leaves linear to filiform; ribs of the fruit filiform.

4. **CARUM.**

Divisions of the leaves lanceolate; ribs of the fruit thick obtuse wings.

5. **CICUTA.**

Stylopodium flat or wanting; petals yellow.

Ribs broad and corky.

Dwarf caespitose alpine subcaulescent plants; fruit not tuberculate.

6. **OREOXIS.**

Tall plants, 3 dm. high or more; fruit tuberculate-roughened.

7. **HARBOURIA.**

Ribs not corky.

Tall and branching, leafy-stemmed plants with broad leaf-divisions; ribs inconspicuous.

8. **ZIZIA.**

Acaulescent and caespitose plants; ribs of the fruit prominent.

9. **ALETES.**

Oil-tubes more than one in the intervals.

Stylopodium conical.

Fruit round, with globose carpels and very slender inconspicuous ribs.

10. **BERULA.**

Fruit ovate or oblong, with prominent equal ribs.

11. **LIGUSTICUM.**

Stylopodium flat or wanting.

Seed-face sulcate or decidedly concave.

Ribs filiform.

12. **MUSENION.**

Ribs with broad thin wings.

13. **AULOSPERMUM.**

Seed-face plane or but slightly concave.

Ribs all conspicuously winged.

Leaves pinnate with short crowded and more or less confluent segments; flowers usually purple or white.

14. **PHELLOPTERUS.**

Leaves ternate-pinnate with short linear and pungent segments; flowers usually yellow.

15. **PTERYXIA.**

Ribs not winged.

Lateral ribs thick and corky; the dorsal ones filiform.

16. **OROGENTIA.**

Ribs all corky and equally prominent.

Plant tall and leafy; oil-tubes never present in the dorsal ribs.

17. **SIMUM.**

Plant low, acaulescent; oil-tubes present in the dorsal ribs.

6. **OREOXIS.**

Fruit strongly flattened dorsally, with the lateral ribs more or less prominently winged.

Stylopodium present.

Stylopodium conical.

Plant glabrous with linear to lanceolate leaf-segments.

Sepals evident; leaves in our species simply pinnate; oil-tubes solitary in the intervals.

18. **OXYPOLIS.**

- Sepals obsolete; leaves in ours three to four times compound; oil-tubes 2 or more in the lateral intervals. 19. *CONIOSELINUM*.
 Plant villous; leaves ternate with rounded-cordate, lobed leaflets; sepals obsolete. 20. *HERACLEUM*.
 Stylopodium depressed.
 Dorsal ribs prominent or winged.
 Plant caulescent, branched; sepals mostly obsolete; petals white. 21. *ANGELICA*.
 Plant acaulescent or nearly so; sepals evident; petals in most yellow. 22. *CYNOMARATHRUM*.
 Dorsal wings filiform; petals yellow; sepals obsolete; plant caulescent. 23. *PASTINACA*.
 Stylopodium wanting; plant acaulescent or nearly so.
 Lateral wings of the fruit thin. 24. *LOMATIUM*.
 Lateral wings of the fruit thick.
 Dorsal ribs very prominent or winged. 25. *PSEUDOCYMOPTERUS*.
 Dorsal ribs filiform.
 Dwarf plants with pinnate or bipinnate leaves and conspicuous involuclers. 26. *CYMOPTERUS*.
 Tall and stout plants with three or four times compound leaves and involuclers of small bractlets. 27. *LEPTOTAENIA*.

1. *SANICULA* L. SNAKE-ROOT.

1. *Sanicula marilandica* L. In rich woods from Newf. and Wash. to Ga. and Colo.—Alt. 4000–6500 ft.—Pike's Peak; foot-hills, Larimer Co.; mouth of Cheyenne Cañon; Spring Cañon; Pennock's mountain ranch; Dixon Cañon.

2. *WASHINGTONIA* Raf. SWEET CICELY.

Involuclers of several bractlets. 1. *W. longistylis*.
 Involuclers lacking or of a single small bractlet. 2. *W. obtusa*.

1. *Washingtonia longistylis* (Torr.) Britton. (*Osmorrhiza longistylis* Torr.) In woods and copses from N. Sc. and Ass. to Ga. and Colo.—Alt. 4000–6000 ft.—Foot-hills, Larimer Co.; Horsetooth Gulch; Buckthorn Creek, Larimer Co.

2. *Washingtonia obtusa* C. & R. (*Osmorrhiza nuda* Porter; not Torr.) In woods from Alb. to N. M. and Calif.—Alt. 6000–12,000 ft.—South Cheyenne Cañon; Rifle, Garfield Co.; headwaters of Pass Creek; four miles west of Cameron Pass; Cedar Edge; Jack Brook; Upper West Mancos Cañon; near La Plata Post Office; headwaters of Sangre de Cristo Creek; near Pagosa Peak; Wahatoya Cañon; Pennock's mountain ranch; gulch east of Stove Prairie; above Beaver Creek; Rabbit-Ear Range.

3. *GLYCOSMA* Nutt.

1. *Glycosma occidentalis* Nutt. (*Osmorrhiza occidentalis* Torr.) On hill-sides and valleys from Alb. and Wash. to Colo. and Calif.—Alt. up to 10,000 ft.—Mountains north of Bear River below Steamboat Springs, Routt Co.; Bob Creek, West La Plata Mountains; Rabbit-Ears, Larimer Co.

4. *CARUM* L. CARAWAY.

Leaves twice pinnately divided. 1. *C. Carui*.
 Leaves once pinnately divided. 2. *C. Gairdneri*.

1. *Carum Carui* L. Escaped from cultivation, in waste places from Newf. and Mont. to Pa. and Colo.—Alt. up to 9500 ft.—Ft. Collins; mountains between Sunshine and Ward.

2. *Carum Gairdneri* (H. & A.) A. Gray. In valleys from Alb. and Wash. to Colo., Ariz. and Calif.—Steamboat Springs; near Bear River, above Hayden, Routt Co.

5. *CICUTA* L. WATER HEMLOCK, MUSQUASH ROOT.

1. *Cicuta occidentalis* Greene. (*C. maculata* Coulter; not L.) In water and wet meadows from N. D. and Ida. to N. M. and Calif.—Alt. 5000-8000 ft.—Trinidad; Iola; Pagosa Springs; Ft. Collins; Wahatoya Creek.

6. *OREOXIS* Raf.

Involucels linear, entire.

Oil-tubes more than one in the intervals; plant glabrous.

1. *O. humilis*.

Oil-tubes solitary in the intervals; plant usually puberulent.

2. *O. alpina*.

Involucels ovate or lanceolate, toothed.

3. *O. Bakeri*.

1. *Oreoxis humilis* Raf. On the higher peaks of Colo.—Alt. 11,000-13,000 ft.—Pike's Peak; Bear Creek Divide; West La Plata Mountains; Mount Garfield.

2. *Oreoxis alpina* (A. Gray) C. & R. (*Cymopterus alpinus* A. Gray) On the higher peaks of Colo. and Utah.—Alt. 10,000-12,000 ft.—Georgetown; headwaters of Clear Creek; Gray's Peak; mountains above Boreas; mountain near Veta Pass; Mount Ouray; Bob Creek Divide, West La Plata Mountains; above Beaver Creek; Cameron Pass; Berthoud Pass.

3. *Oreoxis Bakeri* C. & R. On the higher peaks of Colo.—Alt. 10,000-13,000 ft.—Alpine Tunnel; Mt. Hayden; near Pagosa Peak; West Spanish Peak; Mount Ouray.

7. *HARBOURIA* C. & R.

1. *Harbouria trachypleura* (A. Gray) C. & R. (*Cicuta trachypleura* S. Wats.) In mountains from Wyo. to N. M.—Alt. 5000-10,000 ft.—Foot-hills near Golden; Bosworth's ranch, Stove Prairie; foot-hills west of Ft. Collins; foot-hills, Larimer Co.; Horsetooth Gulch; Rist Cañon; Howe's Gulch; gulch west of Pennock's; west of Soldier Cañon; mountains between Sunshine and Ward; Boulder; Empire.

8. *ZIZIA* Koch. MEADOW PARSNIP, ALEXANDERS.

1. *Zizia cordata* (Walt.) Koch. In wet meadows and woods from Conn., Sask. and Wash. to Ga., Ala. and Utah.—South Park; Pinkham Creek, Larimer Co.

9. *ALETES* C. & R.

Peduncles longer than the leaves; branches of the umbels short.

Leaflets rounded-obovate in outline; their teeth ovate.

1. *A. obovata*.

Leaflets rhombic-cuneate in outline, incised-toothed with lanceolate acuminate teeth.

2. *A. acaulis*.

Peduncles shorter than the leaves; branches of the umbels nearly as long as the peduncles.

3. *A. humilis*.

1. *Aletes obovata* Rydb. On the mountains of Colo.—Alt. about 7000 ft.—Golden; Lower Boulder Cañon, Boulder Co.; near Morrison.

2. *Aletes acaulis* (Torr.) C. & R. (*Deweya acaulis* Torr.; *Carum Hallii* S. Wats.) In the mountains of Colo. and N. M.—Alt. up to 10,000 ft.—Near Morrison; South Table Mountain; Golden; gulch south of Boulder; mountains between Sunshine and Ward.

3. *Aletes humilis* C. & R. In the mountains of Colo.—Dale Creek, Larimer Co.

10. **BERULA** Hoffm. CUT-LEAVED WATER PARSNIP.

1. *Berula erecta* (Huds.) Coville. (*B. angustifolia* Koch) In water from Ills., Minn. and B. C. to Tex. and Calif.—Alt. 4000-6000 ft.—Ft. Collins; Poudre flats; Boulder.

11. **LIGUSTICUM** L. LOVAGE, ANGELICA.

Leaves twice or thrice compound; first divisions ternate.

Stem leafy; divisions of the leaves not filiform.

Leaves thin, dark green.

Leaves thicker, pale green.

Plant subscapose or with a single leaf; ultimate divisions of the leaves linear-filiform.

Leaves once pinnate; plant scapose.

1. *L. Porteri*.

2. *L. affine*.

3. *L. tenuifolium*.

4. *L. Eastwoodii*.

1. *Ligusticum Porteri* C. & R. In mountain woods from Wyo. to N. M. and Ariz.—Alt. 8000-12,000 ft.—Lake City; near La Plata Post Office; Engelmann Cañon; Georgetown; headwaters of Pass Creek; headwaters of Sangre de Cristo Creek; Turkey Creek and tributaries; Veta Mountain; Mirror Lake; near Pagosa Peak; Columbine; Cerro Summit; Crested Butte; mountains west of Steamboat Springs; mountains between Sunshine and Ward.

2. *Ligusticum affine* A. Nels. Open, moist hillsides in Wyo. and Colo.—Summit of North Park Range, Larimer Co.

3. *Ligusticum tenuifolium* S. Wats. In mountain woods from Ida. and Ore. to Colo.—Middle Park; South Park.

4. *Ligusticum Eastwoodii* C. & R. In the mountains of Colo. and S. Wyo.—Alt. 10,000-11,000 ft.—Mountains above Ouray; Bear Creek Divide; Pagosa Peak; Kebler Pass; La Plata Mountains.

12. **MUSENION** Raf.

Fruit glabrous or slightly puberulent.

Fruit strongly scabrous puberulent.

1. *M. divaricatum*.

2. *M. angustifolium*.

1. *Musenion divaricatum* (Pursh) C. & R. In dry ground from Ass. and Alb. to S. D. and Colo.—Alt. 4000-6000 ft.—North Denver; outside of Dixon Cañon; north of La Porte; foot-hills, Larimer Co.; Spring Cañon; west of Loveland; Boulder.

2. *Musenion angustifolium* Nutt. In arid valleys in hard ground of Ass. and Alb. to Colo.—Alt. 4000-5000 ft.—Plains near Denver.

13. **AULOSPERMUM** C. & R.

Clusters of leaves and peduncles borne at the summit of a more or less elongated stem.

Corolla yellow.

Rachis of the primary leaf-segments dilated; secondary segments confluent, broad, toothed or merely cleft.

Rachis of the primary leaf-segments not dilated; secondary segments distinct, finely dissected into small oblong lobes.

Corolla purple.

Leaves clustered at the base; plant acaulescent.

1. *A. longipes*.

2. *A. angustum*.

3. *A. planosum*.

4. *A. purpureum*.

1. *Aulospermum longipes* (S. Wats.) C. & R. (*Cymopterus longipes* S. Wats.) In dry soil from Wyo. to Colo. and Utah.—Yampa River.

2. *Aulospermum angustum* Osterhout. In dry places of Colo.—Steamboat Springs; Hayden.

3. *Aulospermum planosum* Osterhout. In dry places of Colo.—Minturn; Steamboat Springs.

4. *Aulospermum purpureum* (S. Wats.) C. & R. (*Cymopterus purpureus* S. Wats.) In dry places from Colo. and Utah to N. M. and Ariz.—Alt. 6000-7000 ft.—Mancos; Cimarron; Durango; Ridgway.

14. *PHELLOPTERUS* Nutt.

Peduncles, even in fruit, shorter than the leaves; fruit 6-8 mm. long.

1. *P. montanus*.

Peduncles, at least in fruit, equalling or exceeding the leaves; fruit over 8 mm. long.

Involucels 1-3-nerved.

2. *P. purpurascens*.

Involucels 5-9-nerved.

3. *P. camporum*.

1. *Phellopterus montanus* Nutt. (*Cymopterus montanus* T. & G.) In dry places from S. D. and Wyo. to Ark. and Colo.—Alt. 4000-7000 ft.—Colorado Springs; Ft. Collins; Pueblo; New Windsor; Denver.

2. *Phellopterus purpurascens* (A. Gray) C. & R. (*Cymopterus montanus purpurascens* A. Gray) In dry places from Colo. and Utah to Tex. and Ariz.—In Colorado it is represented only by the var. *Eastwoodiae* (Jones) C. & R. which is more robust, with more open inflorescence and narrower wings to the fruit.—Alt. 6000-8000 ft.—Hermosa; Mancos; Cerro Summit.

3. *Phellopterus camporum* Rydb. Dry mesas of S. Colo.—Alt. about 5000 ft.—Mesas near Pueblo.

15. *PTERYXIA* Nutt.

1. *Pteryxia foeniculacea* Nutt. (*Cymopterus foeniculaceus* T. & G.) In dry places from Ida. and Wash. to Colo., Utah and Ore.—Alt. about 8500 ft.—Columbine; Steamboat Springs.

16. *OROGENIA* S. Wats. TURKEY PEA.

1. *Orogenia linearifolia* S. Wats. On mountain ridges from Ida. and Wash. to Colo. and Ore.—Mancos; Rabbit-Ears, Routt Co.; Steamboat Springs.

17. *SIUM* L. WATER PARSNIP.

1. *Sium cicutaefolium* Gmelin. In water from Newf. and Mackenzie to Va. and Calif.—Alt. 4000-8000 ft.—Parlin, Gunnison Co.; Gunnison; San Luis Valley.

18. *OXYPOLIS* Raf.

1. *Oxypolis Fendleri* (A. Gray) Heller. (*Archemora Fendleri* A. Gray) Along brooks and in springy places from Wyo. to N. M.—Alt. 8000-11,000 ft.—Headwaters of Clear Creek; Upper Corral Creek; Idaho Springs; Marshall Pass; Ruby; Robinson; near Pagosa Peak; East Indian Creek; mountain near Veta Pass; headwaters of Sangre de Cristo Creek; Grayback mining

camp and Placer Gulch; Cameron Pass; headwaters of Pass Creek; Bob Creek; Gypsum Creek Cañon, Eagle Co.; Beaver Creek; Berthoud Pass; between Sunshine and Ward.

19. **CONIOSELINUM** Hoof. HEMLOCK PARSNIP.

1. *Conioselinum scopulorum* (A. Gray) C. & R. (*Ligusticum scopulorum* A. Gray) In mountain wood from Colo. to N. M. and Ariz.—Alt. 7000–11,000 ft.—Headwaters of Clear Creek; near Empire; Iron-ton Park, 9 miles south of Ouray; Robinson; Red Mountain road south of Ouray; Alpine Tunnel; Marshall Pass; mountains, Larimer Co.; Crested Butte; Cumbres; Rabbit-Ear Pass; Palmer Lake; Breckenridge; cañon west of Palmer Lake; Elk Cañon; Ouray; Empire.

20. **HERACLEUM** L.

1. *Heracleum lanatum* Michx. In wet ground from Vt. and Alaska to N. C. and Calif.—Alt. 5000–10,000 ft.—Ruxton Brook; west of Ouray; Gunnison; Pagosa Springs; north Cheyenne Cañon; Ft. Collins; Mancos; Baxter's ranch; along the Poudre; between Sunshine and Ward.

21. **ANGELICA** L. ANGELICA.

Oil-tubes mostly solitary in the intervals, not continuous around the seed; rays of the umbels ascending.

Involucels of many-lanceolate, long-acuminate bractlets.

1. *A. Grayi*.

Involucels none, or a few linear-subulate or filiform bractlets.

2. *A. pinnata*.

Oil-tubes continuous around the seeds; rays of the umbels widely spreading.

3. *A. ampla*.

1. *Angelica Grayi* C. & R. In the mountains of Colo. and S. Wyo.—Alt. 9000–13,000 ft.—Headwaters of Clear Creek; Pike's Peak; Silver Plume; near Pagosa Peak; Cameron Pass; Little Kate Basin, La Plata Mountains; Graymont; West Spanish Peak; Keblar Pass; Boreas; Beaver Creek.

2. *Angelica pinnata* S. Wats. In wet meadows from Alb. to N. M. and Utah.—Alt. 7000–8500 ft.—Gunnison Co.; Squaw Hill above Cimarron; Empire.

3. *Angelica ampla* A. Nels. In wet meadows of Wyo. and Colo.—Alt. about 7000 ft.—Cheyenne Mountain; north of Cheyenne Cañon; southeast of Jefferson, South Park.

22. **CYNOMARATHRUM** Nutt.

1. *Cynomarathrum Eastwoodii* C. & R. Low plains of western Colo.—Grand Junction; Mesa County.

23. **PASTINACA** L. PARSNIP.

1. *Pastinaca sativa* L. Cultivated and escaped around dwellings from Vt. and Wash. to Fla. and Calif.—Boulder.

24. **LOMATIUM** C. & R.

Plants slender with thick rounded corms; corolla yellow. 1. *L. leptocarpum*.
 Plant generally stouter from a thickened root or rootstock, rarely corm-like.

Bractlets lanceolate, oblong or linear; corolla white.

Bractlets scarious-margined, as well as the whole plant puberulent or rarely glabrate. 2. *L. orientale*.

Bractlets not scarious-margined, villous. 3. *L. macrocarpum*.

Bractlets of the involuclers none or very few, linear or subulate; corolla yellow.

Leaves finely dissected with numerous small divisions. 4. *L. Grayi*.

Leaves once to thrice ternate with comparatively large divisions.

5. *L. platycarpum*.

1. *Lomatium leptocarpum* (Nutt.) C. & R. (*Peucedanum leptocarpum* Nutt.) On plains and hillsides from Ida. and Ore. to Colo. and Calif.—Steamboat Springs.

2. *Lomatium orientale* C. & R. (*Peucedanum nudicaule* Nutt., mainly) On dry plains from S. D., Mont. and Ida. to Kans., N. M. and Ariz.—Alt. 4000-8000 ft.—Plains near Denver; foot-hills west of Ft. Collins; mountains, Larimer Co.; Calhan; vicinity of Horsetooth; Horsetooth Gulch; Dixon Cañon; Empire.

3. *Lomatium macrocarpum* (Nutt.) C. & R. (*Peucedanum macrocarpum* Nutt.) Dry hills and plains from Sask. and B. C. to Colo. and Calif.—Egeria Park, Routt County.

4. *Lomatium Grayi* C. & R. On dry plains and hills from Wyo. and Wash. to Colo. and Ore.—Alt. up to 7000 ft.—Mancos; Durango; Los Pinos; Glenwood Springs.

5. *Lomatium platycarpum* (Torr.) C. & R. (*Peucedanum simplex* Nutt.) On hillsides from Alb. and Wash. to Colo. and Ore.—Alt. 6000-8000 ft.—Above Mancos; Mancos; Cerro Summit; Glenwood Springs; Fort Lewis.

25. **PSEUDOCYMOPTERUS** C. & R.

Plant more or less caulescent; leaves thin.

Petals yellow.

Ultimate divisions or teeth of the leaves short, ovate to lanceolate; leaves ovate in outline. 1. *P. montanus*.

Ultimate divisions of the leaves linear, elongated.

Leaves ovate in outline, at least the basal ones. 2. *P. sylvaticus*.

Leaves, at least the basal ones, broadly rhombic in outline.

Plant slender; leaves mostly twice compound with very long and few divisions. 3. *P. tenuifolius*.

Plant low; leaves thrice pinnate with shorter, crowded numerous divisions. 4. *P. multifidus*.

Petals purple. 5. *P. purpureus*.

Plants acaulescent with thick or firm leaves.

Primary divisions of the leaves once or twice dissected with narrowly linear divisions. 6. *P. anisatus*.

Primary divisions broad, cuneate-flabellate, cleft and toothed with short ovate or lanceolate teeth. 7. *P. aetifolius*.

1. *Pseudocymopterus montanus* (A. Gray) C. & R. (*Ligusticum montanum* B. & H.) In mountain woods from Wyo. to N. M. and Ariz.—Alt. 8000-12,500 ft.—Headwaters of Clear Creek; Clear Creek Cañon; Cumbres; Cumberland Basin, La Plata Mountains; Los Pinos; hills above Mancos; West Indian Creek; Sangre de Cristo Cañon; Cameron Pass; Alpine Tunnel;

Idaho Springs; Larimer Co.; Ironton Park, 9 miles south of Ouray; mountain near Veta Pass; Pass Creek; Piedra; near Pagosa Peak; Gore Pass; Rico; Leroux Creek, Delta Co.

2. *Pseudocymopterus sylvaticus* A. Nels. In woods of Colo. and Wyo.—Alt. 8000–12,000 ft.—Gulch, Mt. Harvard; Clear Creek Cañon near Georgetown; Keblar Pass; Pike's Peak; Veta Pass; Hahn's Peak; mountains, Larimer Co.; West Indian Creek; Turkey Creek and tributaries; Veta Mountain; Seven Lakes; Bosworth's; William's Cañon above Manitou; above Beaver Creek; Dillon Cañon; Empire; mountains between Sunshine and Ward.

3. *Pseudocymopterus tenuifolius* (A. Gray) Rydb. (*Thaspium montanum tenuifolium* A. Gray) In mountain woods from Colo. to N. M. and Ariz.—Alt. 8000–10,000 ft.—Engelmann Cañon; William's Cañon; Minnehaha; East Indian Creek; Lake City; vicinity of Como.

4. *Pseudocymopterus multifidus* Rydb. (*P. montanus multifidus* Rydb.) In mountain woods of Colo.—Alt. 8000–10,000 ft.—Lake City; Ironton, San Juan Co.; Wahatoya Cañon; Ironton Park, 9 miles south of Ouray; Seven Lakes.

5. *Pseudocymopterus purpureus* (C. & R.) Rydb. (*P. montanus purpureus* C. & R.) In the mountains of Colo., Utah, N. M. and Ariz.—Alt. about 11,500 ft.—Mt. Ouray; Garfield.

6. *Pseudocymopterus anisatus* (A. Gray) C. & R. (*Cymopterus anisatus* A. Gray) On mountains among rocks from Wyo. and Nev. to Colo. and Utah.—Alt. 9000–11,000 ft.—Headwaters of Clear Creek; Ute Pass, Colorado Springs; Silver Plume; Little Veta Mountain; West Spanish Peak.

7. *Pseudocymopterus aletifolius* Rydb. In the mountains of Colo. among rocks.—Alt. 6000–10,000 ft.—Minnehaha; Cheyenne Mountain; Pike's Peak; Ruxton; North Cheyenne Cañon; Manitou; South Cheyenne Cañon.

26. CYMPTERUS Raf.

Umbels dense, globular; petals white; involucre wanting.

Ultimate divisions of the leaves linear or linear-oblong, acutish.

1. *C. acaulis*.

Ultimate divisions of the leaves short, broadly oblong, obtuse.

2. *C. Parryi*.

Umbels open; petals yellow; involucre present, although often a mere vestige.

Divisions of the leaves narrow.

3. *C. Fendleri*.

Divisions of the leaves broad.

4. *C. Newberryi*.

1. *Cymopterus acaulis* (Pursh) Rydb. (*C. glomeratus* DC.; *C. campestris* T. & G.) In dry arid places from N. D. and Ass. to Ark. and Colo.—Alt. 4000–8000 ft.—Larimer Co.; Walsenburg; plains near Denver; mesas near Pueblo; Cucharas Valley near La Veta; butte 5 miles southwest of La Veta; Ft. Collins; Poudre River.

2. *Cymopterus Parryi* (C. & R.) Jones. (*Coloptera Parryi* C. & R.) In dry places from Mont. to Neb. and Colo.—McCoy's, Eagle Co.

3. *Cymopterus Fendleri* A. Gray. In dry places of Colo., Utah and N. M.—Westwater; Mancos; Grand Junction.

4. *Cymopterus Newberryi* (S. Wats.) Jones. In dry places of Colo., Utah and N. M.—Westwater.

27. **LEPTOTAENIA** Nutt.

Fruit 8-12 mm. long, usually without oil-tubes; leaves finely dissected into linear divisions.

1. *L. multifida*.

Fruit 15-18 mm. long, with oil-tubes; leaves less dissected into oblong divisions.

2. *L. Eatoni*.

1. *Leptotaenia multifida* Nutt. In rich soil from Alb. and Wash. to Colo. and Calif.—Near Dix Post Office; Durango; Glenwood Springs; Baldwin; Spicer.

2. *Leptotaenia Eatoni* C. & R. In rich soil from Wyo. and Ida. to Utah and Colo.—Alt. 7000-8000 ft.—Los Pinos; Cerro Summit; Minturn.

Order 39. **ERICALES.**

Gynoecium superior; fruit usually capsular.

Herbaceous saprophytes without green leaves.

Herbs or shrubs with green leaves.

Corolla of essentially distinct petals; herbs with rootstocks.

101. **MONOTROPACEAE.**

102. **PYROLACEAE.**

103. **ERICACEAE.**

104. **VACCINIACEAE.**

Corolla of more or less united petals; shrubs.

Gynoecium inferior; fruit baccate or drupaceous.

Family 101. **MONOTROPACEAE** Lindl. INDIAN-PIPE FAMILY.1. **PTEROSPORA** Nutt. PINE DROP, GIANT BIRD'S-NEST.

1. *Pterospora andromedea* Nutt. In rich woods from Que. and B. C. to Pa., Ariz. and Calif.—Alt. 4000-8000 ft.—Bosworth's ranch, Stove Prairie; mountains, Larimer Co.

Family 102. **PYROLACEAE** Agardh. WINTERGREEN FAMILY.

Plants leafy-stemmed; flowers corymbose; style very short and covered by the peltate stigma; filament dilated and hairy at the middle.

1. **CHIMAPHILA.**

Plants scapiferous with a basal rosette of leaves; flowers racemose or solitary; style evident; filaments subulate, naked.

Flowers solitary; petals spreading; valves of the capsule not cob-webby on the edges.

2. **MONESES.**

Flowers racemose; petals more or less converging, concave; valves of the capsule cob-webby on the edges when opening.

3. **PYROLA.**

1. **CHIMAPHILA** Pursh. PIPSISSEWA.

1. *Chimaphila umbellata* (L.) Nutt. In woods from N. S. and Alaska to Ga. and Calif.—Alt. 8000-11,000 ft.—Estes Peak, Larimer Co.; North and South Boulder Peak; Bierstadt Lake; Beaver Creek.

2. **MONESES** Salisb. ONE-FLOWERED WINTERGREEN.

1. *Moneses uniflora* (L.) S. F. Gray. In wet woods from Lab. and Alaska to Pa., Colo. and Ore.—Alt. 9000-12,000 ft.—Silverton; Marshall Pass; Front Range, Larimer Co.; Ruby; Caribou; Steamboat Springs; camp on Little Beaver Creek; Berthoud Pass.

3. *PYROLA* L. WINTERGREEN.

Flowers with a 10-lobed hypogynous disk; stigma peltate, 5-lobed; petals with a pair of tubercles at the base. 1. *P. secunda*.

Flowers without hypogynous disk and petals without tubercles.

Style straight and short; stigma peltate; stamens equally connivent around the pistil. 2. *P. minor*.

Style and stamens declined; stigma much narrower than the concave apex of the style, which forms a collar or ring.

Leaves not mottled.

Petals pink or purplish.

Leaf-blades round-reniform.

Leaf-blades orbicular or round-ovate.

Petals white or greenish.

Leaves mottled.

3. *P. asarifolia*.

4. *P. uliginosa*.

5. *P. chlorantha*.

6. *P. picta*.

1. *Pyrola secunda* L. In damp woods from Lab. and Alaska to D. C. and Calif.—Alt. 6000–12,000 ft.—Grand Lake; Mt. Abram, Ouray; Echo Cañon; Box Cañon, west of Ouray; Pagosa Peak; Steamboat Springs, Routt Co.; Mt. Harvard; Cheyenne Mountain; Beaver Creek; mountains between Sunshine and Ward; Fish Creek Falls.

2. *Pyrola minor* L. In woods from Greenl. and Alaska to Conn. and Calif.—Alt. 8000–12,000 ft.—Headwaters of Clear Creek; Grand Lake; Marshall Pass; chaparral-covered hills southeast of Ouray; Artist's Glen, near Pike's Peak; Silver Plume; La Plata Cañon; Cameron Pass; Graymont; Beaver Creek.

3. *Pyrola asarifolia* Michx. In damp woods from N. B. and Alb. to N. Y. and Colo.—Alt. 9000–12,000 ft.—West Spanish Peak; Graymont.

4. *Pyrola uliginosa* Torr. (*P. rotundifolia uliginosa* A. Gray) In wet rich woods and swampy places from N. S. and B. C. to N. Y., Colo. and Calif.—Alt. 7000–12,000 ft.—Headwaters of Clear Creek; South Boulder Peak; Grand Lake; Marshall Pass; Ouray; Berthoud Pass, near Cozzens; Keblar Pass; Steamboat Springs; Beaver Creek.

5. *Pyrola chlorantha* Swartz. In woods from Lab. and B. C. to D. C., Colo. and Calif.; also in Europe.—Alt. 9000–12,000 ft.—Marshall Pass; Hamor's Lake, north of Durango; 4 miles west of Cameron Pass; Cheyenne Mountains; Front Range, Larimer Co.; Gore Pass; swamp above Beaver Creek.

6. *Pyrola picta* Smith. In woods from Ida. and Wash. to Colo., Ariz. and Calif.—Alt. 8000–9000 ft.—Cañons and adjoining meadows west of Ouray.

Family 103. *ERICACEAE* DC. HEATH FAMILY.

Fruit more or less fleshy or surrounded by a fleshy calyx or hypanthium; plants prostrate, evergreen; corolla without sacs.

Fruit a berry or drupe, not enclosed in the calyx.

Fruit a loculicidal capsule, enclosed in the accrescent fleshy calyx and hypanthium. 1. *ARCTOSTAPHYLOS*.

Fruit dry, a septicidal capsule; erect bog-shrubs. 2. *GAULTHERIA*.

Corolla saucer-shaped with 10 sacs for the anthers. 3. *KALMIA*.

Corolla campanulate without sacs. 4. *PHYLLODOCE*.

1. *ARCTOSTAPHYLOS* Adans. BEAR-BERRY, KINNIKINIC.

1. *Arctostaphylos uva-ursi* (L.) Spreng. In woods, on hillsides and sandy soil from Lab. and Alaska to N. J., Colo. and Ore.—Alt. 5000–10,000 ft.—

Arkansas Junction near Leadville; Dillon; Idaho Springs; South Cheyenne Cañon; mountains north of Cascade; West Mancos Cañon; mountains, Larimer Co.; Golden; west of Ft. Collins; Stove Prairie, Larimer Co.; Pike's Peak; Manitou; Eldora; mountains between Sunshine and Ward; Bear Creek Cañon.

2. **GAULTHERIA** L. CREEPING WINTERGREEN.

1. *Gaultheria humifusa* (Graham) Rydb. (*Vaccinium humifusum* Graham; *Gaultheria Myrsinitis* Hook.) On wooded hillsides from Mont. and B. C. to Colo. and Calif.—Alt. about 11,000 ft.—Buffalo Pass, Park Range; headwaters of Clear Creek; summit of North Park Range, Larimer Co.

3. **KALMIA**. AMERICAN OR SWAMP LAUREL.

1. *Kalmia microphylla* (Hook.) Heller. (*K. glauca microphylla* Hook.) In mountain swamps from Alb. and Alaska to Colo. and Calif.—Alt. 10,000–11,000 ft.—Caribou; Long's Peak; Buffalo Pass; summit of North Park Range, Larimer Co.

4. **PHYLLODOCE** Salisb.

1. *Phyllodoce empetriformis* (Smith) Don. Swamps and mountain sides from Alaska to northern Calif., Colo. and Alb.—Alt. up to 11,000 ft.—Grizzly Gulch, near Gray's Peak.

Family 104. **VACCINIACEAE** Lindl. HUCKLEBERRY FAMILY.

1. **VACCINIUM** L. BLUE-BERRY, HUCKLEBERRY, BILBERRY.

Branches not angled.

1. *V. caespitosum*.

Branches angled.

Fruit purplish-black; leaves over 1 cm. long.

2. *V. oreophilum*.

Fruit bright red; leaves usually less than 1 cm. long.

3. *V. erythrococtum*.

1. *Vaccinium caespitosum* Michx. In arctic and alpine regions from Lab. and Alaska to N. H., Colo. and Wash.—Alt. 8000–12,000 ft.—Headwaters of Clear Creek, near Empire; Middle Park; Mirror Lake; Tennessee Pass, 7 miles west of Leadville; Damfino Creek; Cameron Pass; Leroux Creek; Eldora to Baltimore; Buffalo Pass; summit of North Park Range, Larimer Co.

2. *Vaccinium oreophilum* Rydb. (*V. Myrtillus* A. Gray; not L.) In woods from Alb. and B. C. to N. M.—Alt. 8000–12,000 ft.—Front Range, Larimer Co.; Bob Creek, West La Plata Mountains; near Pagosa Peak; Keblar Pass; East Indian Creek; mountain near Veta Pass; Valley, Spur; Red Mountain, south of Ouray; head of Bear Creek; Beaver Creek.

3. *Vaccinium erythrococtum* Rydb. (*V. Myrtillus microphyllum* Hook.) On hillsides from Alb. and B. C. to Colo. and Calif.—Alt. 8500–12,000 ft.—Headwaters of Clear Creek, near Empire; Alpine Tunnel; Little Veta Mountain; Beaver Creek; above Cameron Pass; Baltimore; Buffalo Pass; summit of North Park Range, Larimer Co.

Order 40. PRIMULALES.

Family 105. PRIMULACEAE Vent. PRIMROSE FAMILY

Corolla present.

Corolla-lobes erect or spreading; stamens distinct.

Corolla salverform or funnelform, its lobes imbricated; stamens included; plants scapiferous; leaves basal.

Corolla-tube equalling or exceeding the calyx; style filiform; flowers conspicuous. 1. PRIMULA.

Corolla-tube shorter than the calyx; throat constricted; style very short; flowers minute. 2. ANDROSACE.

Corolla rotate, its lobes convolute or involute in the bud; stamens exerted; plants leafy-stemmed.

Flowers axillary, solitary; corolla-lobes broad, curved around the stamens; staminodia conspicuous. 3. STEIRONEMA.

Flowers in axillary short spikes; corolla-lobes long and linear; tube very short; staminodia tooth-like. 4. NAUMBURGIA.

Corolla-lobes reflexed; stamens more or less monadelphous; plants scapiferous. 5. DODECATHEON.

Corolla wanting; calyx with 5 petaloid lobes; flowers solitary, sessile in the axils of the opposite stem-leaves. 6. GLAUX.

1. PRIMULA L. PRIMROSE.

Bracts of the involucre more or less gibbous at the base; lobes of the corolla deeply 2-cleft, i. e., at least one-fourth their length; leaves densely mealy beneath. 1. *P. americana*.

Bracts of the involucre not gibbous below; lobes of the corolla merely emarginate or notched, rarely entire; leaves not mealy.

Plant less than 1 dm. high, 1-few-flowered; flowers less than 2 cm. long.

2. *P. angustifolia*.

Scape 1.5-5 dm. high, many-flowered; flowers over 2 cm. long.

3. *P. Parryi*.

1. *Primula americana* Rydb. (*P. farinosa* Hook.; not L.) In swamps and wet meadows from Ass. and Alb. to Colo.—Alt. about 8000 ft.—Near Lake John, North Park; Gunnison.

2. *Primula angustifolia* Torr. On alpine peaks of Colo.—Alt. 9000-14,400 ft.—Saddle, Pike's Peak; Marshall Pass; Gray's Peak; Pike's Peak; Berthoud Pass near Georgetown; West Spanish Peak; Sierra Blanca; headwaters of Clear Creek.

3. *Primula Parryi* A. Gray. Along cool mountain streams from Mont. to Colo. and Ariz.—Alt. 9000-13,000 ft.—Bottomless Pit, Pike's Peak; Berthoud Pass, near Georgetown; Cameron Pass; Tennessee Pass, 7 miles west of Leadville; tributaries of South Fork of Cache La Poudre River, Larimer Co.; Elk Mountains; Gray's Peak; Slide Rock Cañon; timber line above Cameron Pass; mountains south of Ward, Boulder Co.; Carson; summit of Mt. Garfield; headwaters of Clear Creek; Lake City; Caribou; Graymont; Beaver Creek; Berthoud Pass.

2. ANDROSACE L.

Perennials, caespitose and proliferous; corolla 5-8 mm. in diameter.

1. *A. carinata*.

Annuals, not caespitose-proliferous, or the last one may be perennial by rosettes; corolla 3-4 mm. wide.

Calyx-tube in fruit obpyramidal, its green teeth surpassing the capsule.

Bracts of the involucre ovate or oblong.

2. *A. occidentalis*.

Bracts of the involucre lanceolate or subulate.

Calyx-teeth erect, lanceolate, usually shorter than the tube.

Peduncles, pedicels and calyx-lobes densely puberulent, the latter exceeding the fruit.

3. *A. puberulenta*.

Peduncles and pedicels sparingly puberulent or glabrous; calyx-lobes glabrous or nearly so, not exceeding the fruit.

Corolla longer than the calyx.

Peduncles 1-2 dm. high, many times longer than the strongly ascending or suberect pedicels.

4. *A. pinetorum*.

Peduncles less than 3 cm. high, often equalled or exceeded in length by the spreading pedicels.

5. *A. subumbellata*.

Corolla shorter than the calyx.

6. *A. diffusa*.

Calyx-teeth more or less spreading, ovate-triangular, foliaceous, equalling or exceeding the whitish tube; corolla shorter than the calyx.

7. *A. sublifera*.

Calyx-tube in fruit hemispherical; teeth broadly triangular.

8. *A. filiformis*.

1. *Androsace carinata* Torr. (*A. Chamaejasne* A. Gray; not Host.) On alpine peaks from Alb. to Colo.—Alt. 9000-13,000 ft.—Mt. Evans; Pike's Peak; near the summit of the Rocky Mountains; Bottomless Pit; West Spanish Peak; Iron Mountain.

2. *Androsace occidentalis* Nutt. In dry soil from Ills., Man. and Mont. to Mo., Tex. and Calif.—Alt. 4000-8500 ft.—Mancos; foot-hills, Larimer Co.; Los Pinos (Bayfield); Empire.

3. *Androsace puberulenta* Rydb. On plains and hills from Man., Mackenzie River and Alb. to N. Mex.—Alt. 5000-12,000 ft.—Plains near Boulder; Pike's Peak; Seven Lakes; Wahatoya Cañon; mountain near Veta Pass; headwaters of Sangre de Cristo Creek; Gentian Ridge; Veta Mountain; Ribbon Lake; Marshall Pass; Cucharas River, above La Veta; Little Veta Mountain; near Ironton, San Juan Co.; Mt. Hesperus; Bear Creek Divide, west of Mt. Hesperus; Iron Mountain; Carson.

4. *Androsace pinetorum* Greene. In the mountains from Mackenzie and Yukon to Colo. and Ariz. Scarcely distinct from *A. septentrionalis* L.—Alt. 5000-8000 ft.—Los Pinos (Bayfield); Graham's Park; hills southeast of La Veta; Georgetown; Boulder; Soldier's Cañon; Dolores.

5. *Androsace subumbellata* (A. Nelson) Small. Along mountain streams from Mont. to Colo. and Ariz.—Alt. 9000-12,000 ft.—Berthoud Pass, near Georgetown; Ironton Park, 9 miles south of Ouray; Pike's Peak; Gore Pass; source of Leroux, above Graymont; Beaver Creek; Cameron Pass; Grizzly Creek; Deep Creek.

6. *Androsace diffusa* Small. In the mountains mostly along rivers from Mackenzie and B. C. to N. M. and Ariz.—Alt. 6000-11,000 ft.—Massif de l'Arapahoe; Pike's Peak; Upper La Plata River; Veta Pass; North Park near Teller; along the Michigan; Van Boxle's ranch, above Cimarron; Silver Plume; foot-hills, Larimer Co.; Mancos; Georgetown; Mt. Harvard; on Turkey Creek and tributaries; Glenwood Springs, Garfield Co.; hills above Mancos; Pennock's mountain ranch; vicinity of Como; Bosworth's ranch, Stove Prairie; along Purgatory River, Trinidad; Rist Cañon; above Manitou; gulch west of Pennock's; Dolores.

7. *Androsace subulifera* (A. Gray) Rydb. (*A. septentrionalis subulifera* A. Gray) In the mountains from Mont. to Colo.—Alt. 6000–10,000 ft.—Cascade; Minnehaha; Cameron Pass; Steamboat Springs; Cimarron; Beaver Creek; Mancos; Durango; Pennock's; Dillon Cañon, Trinidad.

8. *Androsace filiformis* Retz. (*A. capillaris* Greene) Along mountain streams from Wash. and Mont. to Colo.—Alt. up to 10,000 ft.—Gore Pass; Middle Park; Grand River, 12 miles below the lake; Steamboat Springs.

3. **STEIRONEMA** Raf. FRINGED LOOSESTRIPE.

1. *Steironema ciliatum* (L.) Raf. In swamps and wet meadows from N. S. and Wash. to Ga. and Ariz.—Alt. 4000–8000 ft.—New Windsor, Weld Co.; Alamosa; Wahatoya Creek; Ft. Collins; Mason's river-front farm; Rist Cañon; Horsetooth Gulch; La Porte; Boulder.

4. **NAUMBURGIA** Moench. TUFTED LOOSESTRIPE.

1. *Naumburgia thyrsoiflora* (L.) Duby. In shallow water and swamps from N. S. and Alaska to Pa., Colo. and Ore.; also in Europe.—Alt. about 5000 ft.—Ft. Collins.

5. **DODECATHEON** L. AMERICAN COWSLIP, SHOOTING STAR.

Anthers subsessile or nearly so; tube of the filaments, if any, less than 0.5 mm. long.

1. *D. multiflorum*.

Anthers not subsessile; filaments united into a distinct tube, 1–3 mm. long.

Anthers more than twice as long as the short filaments.

Leaves entire.

Leaf-blades oval or oblong; bracts oblong, mostly obtuse; plant slender; flowers 1–3 (rarely 4–5).

2. *D. philoscia*.

Leaf-blades oblanceolate; bracts lanceolate, acute; plant usually stout and many-flowered.

3. *D. radiculatum*.

Leaves sinuately dentate.

4. *D. sinuatum*.

Anthers less than twice as long as the filaments.

5. *D. pauciflorum*.

1. *Dodecatheon multiflorum* Rydb. In wet meadows of Colo. and Wyo.—Alt. 8000–9000 ft.—Sangre de Cristo Creek.

2. *Dodecatheon philoscia* A. Nels. In wet meadows of Colo. and Wyo.—Alt. 8000–10,000 ft.—William's Cañon, near Pike's Peak; Walton Creek; Sargent's; Pike's Peak; Ft. Collins.

3. *Dodecatheon radiculatum* Greene. In wet meadows from S. D. and Wyo. to Kans. and N. Mex.—Alt. 7000–11,000 ft.—Eldora to Baltimore; Berthoud Pass; Dark Cañon; Bear Creek Cañon; Grayback mining camps and Placer Gulch; Walden; below Colorado Springs; Idaho Springs; West Indian Creek; Veta Mountain; South Park; East Indian Creek; Lake City; Horsetooth Gulch; forks of Poudre and Big South; gulch west of Dixon Cañon; Pennock's mountain ranch; Hematite; Pike's Peak.

4. *Dodecatheon sinuatum* Rydb. (*D. radiculatum sinuatum* Rydb.) Shady wet banks and wet meadows in Colo.—Alt. 5000–8000 ft.—Foot-hills, Larimer Co.; Buena Vista; foothills west of Ft. Collins.

5. *Dodecatheon pauciflorum* (Durand) Greene. In wet meadows and along streams from Mackenzie and Sask. to Colo.—Alt. about 8500 ft.—Columbine.

6. **GLAUX** L. SEA MILKWORT, BLACK SALTWORT.

1. *Glaux maritima* L. On beaches and in salt marshes from Newf. and Alaska to N. J., Colo. and Ore.—Alt. about 5000 ft.—New Windsor, Weld Co.; Ft. Collins; Cache la Poudre.

Order 41. **OLEALES.**Family 106. **OLEACEAE** Lindl. OLIVE FAMILY.

Fruit a samara.

1. **FRAXINUS.**

Fruit a drupe.

2. **ADELIA.**1. **FRAXINUS** L. ASH.

1. *Fraxinus anomala* Torr. In cañons from western Colo. and Utah to Ariz.—Alt. 4500–5000 ft.—Grand Junction; Deer River; between Hotchkiss and Smith's Fork.

2. **ADELIA** P. Br.

1. *Adelia neo-mexicana* (A. Gray) Kuntze. (*Forestiera neo-mexicana* A. Gray; *F. acuminata parvifolia* A. Gray) On hills from Colo. to Tex. and N. M.—San Juan (*Brandegee*).

Order 42. **GENTIANALES.**

Corolla-lobes convolute or imbricated in the bud; leaves typically opposite and simple.

107. **GENTIANACEAE.**

Corolla-lobes induplicate-valvate in the bud; leaves alternate, in ours mostly basal and trifoliate.

108. **MENYANTHACEAE.**Family 107. **GENTIANACEAE** Dumont. GENTIAN FAMILY.

Style filiform, mostly deciduous; anthers recurving or twisted at maturity.

Corolla small, red, rose or yellowish; tube surpassing the calyx; filaments spirally twisted.

1. **ERYTHRAEA.**

Corolla large, blue, purple or white; tube much shorter than the calyx; stamens recurved.

2. **EUSTOMA.**

Style stout and short or none, persistent.

Corolla without nectariferous pits, glands or scales.

Corolla campanulate, funnelform or salvershaped; calyx 4–5-lobed; stamens inserted in the corolla-tube.

Corolla without plaits or lobes at the sinuses; calyx without an intercalycine membrane; sepals imbricated.

Flowers 4-merous, rather large, usually over 3 cm. long; corolla-lobes more or less fringed or toothed; inner sepals broader, membranous-margined.

3. **ANTHOPOGON.**

Flowers small, 5-merous (seldom 4-merous), less than 2 cm. long; outer sepals the broader; corolla-lobes never fringed, rarely toothed.

4. **AMARELLA.**

Corolla plicate in the sinuses; the plaits more or less extended into membranous lobes or teeth; calyx with an intercalycine membrane; its lobes valvate.

Dwarf annuals or biennials; flowers solitary, terminal; anthers cordate-versatile.

5. **CHONDROPHYLLA.**

Perennials; flowers short-peduncled, at least some of them axillary; anthers linear or oblong, extrorse.

6. **DASYSTEPHANA.**

Corolla rotate; calyx 4–5-parted to near the base; stamens inserted on the base of the corolla.

7. **PLEUROGYNE.**

Corolla with nectariferous glands, pits or scales.

Style none; leaves opposite, rarely alternate; corolla without a crown at the base. 8. SWERTIA.

Style manifest; leaves in ours verticillate; corolla with a crown at the base. 9. FRASERA.

1. ERYTHRAEA Neck. CENTAURY, CANCHALAGUA.

1. *Erythraea arizonica* (A. Gray) Rydb. (*E. calycosa arizonica* A. Gray)
In sandy soil from Colo. and Utah to Ariz.—Hotchkiss, Delta Co.

2. EUSTOMA Salisb.

1. *Eustoma Russellianum* (L.) Griseb. In wet meadows from Neb. and Colo. to La. and N. M.; also Mex.—Alt. 4000–5500 ft.—Tobe Miller's ranch; La Porte, Larimer Co.; Ft. Collins; Denver.

3. ANTHOPOGON Neck. FRINGED GENTIAN.

Annuals or biennials; flowers on naked long peduncles terminating the branches, not bracteate. 1. *A. elegans*.

Perennials; flowers short-peduncled in the axils of two bract-like leaves. 2. *A. barbellatus*.

1. *Anthopogon elegans* (A. Nels.) Rydb. (*Gentiana elegans* A. Nels.) In wet places from Mackenzie to Colo. and Ariz.—Alt. 8000–13,000 ft.—Goose Creek; Westcliffe; 4 miles west of Cameron Pass; White River Plateau; Twin Lakes; McCoy; Columbine; Keblar Pass; North Park; near Pagosa Peak; Grand Lake; Mt. Bartlett; Robinson; Mt. Harvard; North Park near Teller; Long's Peak; Medicine Bow Mountains; Chambers' Lake; South Park at Jefferson; Breckenridge.

2. *Anthopogon barbellatus* (Engelm.) Rydb. (*Gentiana barbellata* Engelm.; *G. Moseleyi* A. Nels.) In mountain meadows and in wet places on the peaks of Colo.—Alt. 9000–12,000 ft.—Mt. Harvard; Pike's Peak; Gentian Dell; near Breckenridge; Gray's Peak; Vance Junction; Cameron Pass.

4. AMARELLA Gilb. GENTIAN.

Flowers solitary on long peduncles; stems depressed, cespitose.

Flowers numerous, short-peduncled; stems erect, leafy, more simple. 1. *A. monantha*.

Calyx-lobes very unequal; two of them large, foliaceous, ovate or oval, much broader than the rest and covering them. 2. *A. heterosepala*.

Calyx-lobes somewhat unequal, but all oblong, lanceolate or linear.

Flowers numerous, crowded, very short-peduncled; the whole inflorescence dense and spike-like; leaves usually equalling or exceeding the internodes. 3. *A. strictiflora*.

Flowers rather few, distinctly peduncled; middle internodes elongated and usually longer than the leaves.

Larger sepals usually half as long as the corolla or longer; plant stout, 2–4 dm. high; stem-leaves lanceolate. 4. *A. scopulorum*.

Sepals less than half as long as the corolla; plant slender, 1–2, seldom 3 dm. high; stem-leaves usually ovate-lanceolate. 5. *A. plebeja*.

1. *Amarella monantha* (A. Nels.) Rydb. (*Gentiana tenella* A. Gray, in part; not Rottb.; *G. monantha* A. Nels.) In wet places of Colo.—Alt. 8000–12,000 ft.—Mirror Lake; headwaters of Clear Creek, near Empire.

2. *Amarella heterosepala* (Engelm.) Greene. (*Gentiana heterosepala* Engelm.) In damp ground in Utah and Colo.—Alt. about 9000 ft.—Near Pagosa Peak; divide road to Steamboat Springs; western Gunnison Co.

3. *Amarella strictiflora* (Rydb.) Greene. (*Gentiana amarella stricta* S. Wats.; *G. strictiflora* Rydb.) On hillsides and damp places from Sask. and Alaska to Colo. and Calif.—Alt. 7500–12,000 ft.—Empire; mountains between Sunshine and Ward; Gunnison; Lake John; North Park; Mt. Harvard; Ribbon Lake; Estes Park, Larimer Co.; Seven Lakes; Chambers' Lake; Bottomless Pit, Pike's Peak; headwaters of Clear Creek near Empire; Bergen Park; South Park, southeast of Jefferson; Baxter's ranch.

4. *Amarella scopulorum* Greene. (*Gentianella Clementis* Rydb.) In damp places from Mont. and S. D. to Colo. and Ariz.—Alt. 9000–12,000 ft.—Clear Lake; Idaho Springs; Palsgrove Cañon; Ruxton Dell; Minnehaha; Middle Park; below Half-way House, Pike's Peak; Graymont; Hamor's Lake above Durango; Artist's Glen near Pike's Peak; Pike's Peak; Silver Plume; headwaters of Clear Creek; Bosworth's ranch.

5. *Amarella plebeja* (Cham.) Greene. (*Gentiana plebeja* Cham.; *G. Amarella acuta* A. Gray; not Hook.) In wet places from Mackenzie and Alaska to Colo. and Calif. (?).—Alt. 8000–10,000 ft.—Georgetown; Middle Park, near Cozzens; Marshall Pass; Grand Lake; Deep Creek Lake; north of Steamboat Springs; vicinity of Pine Grove.

Amarella plebeja Holmii (Wettst.) Rydb. (*Gentiana plebeja* Holmii Wettst.; *G. Amarella nana* Engelm.) A low alpine variety.—Alt. 10,000–12,000 ft.—Caribou; Buffalo Pass; Breckenridge.

5. CHONDROPHYLLA (Bunge) A. Nels.

Leaves and calyx-lobes with broad scarious margins; the capsule long-stipitate and at last exserted from the corolla.

Leaves and calyx-lobes slightly scarious-margined; capsule short-stipitate, not exserted.

1. *C. Fremontii*.

2. *C. americana*.

1. *Chondrophylla Fremontii* (Torr.) A. Nels. (*Gentiana humilis* Engelm.; not Stev.; *G. Fremontii* Torr.) On alpine wet brook-banks in Wyo. and Colo.—Alt. 7000–10,000 ft.—Gunnison; headwaters of Sangre de Cristo Creek; headwaters of Clear Creek; Georgetown; Como.

2. *Chondrophylla americana* (Engelm.) A. Nels. (*Gentiana prostrata* Hook.; not Henke.; var. *Americana* Engelm.) In wet places along streams from Alb. and Alaska to Colo.—Alt. 10,000–12,000 ft.—Wilson, San Miguel Co.; "Colorado"; northeast of Boreas.

6. DASYSSTEPHANA Adans. CLOSED GENTIAN.

Testa of the seeds lamellose-rugose; the lamellae white, forming hexagonal areolas; basal leaf-rosette remaining at flowering time.

Testa of the seeds smooth, but often produced into wings; basal rosette none.

Floral leaves more or less broadened and more or less scarious; seeds usually wingless.

Floral leaves narrow, not scarious; seeds winged.

Leaves all except the floral ones ovate, oblong or lanceolate.

Calyx-lobes well developed; calyx-tube truncate at the apex.

3. *D. affinis*.

Calyx-lobes none or minute; calyx-tube irregular, more or less lobed or cleft.

4. *D. Forwoodii*.

Upper stem-leaves linear or lance-linear.

Flower-cluster dense; its branches and internodes very short.

5. *D. Bigelovii*.

Flower cluster lax, its branches and internodes elongated.

6. *D. interrupta*.

1. *Dasystephana Romanzovii* (Ledeb.) Rydb. (*Gentiana Romanzovii* Ledeb.; *G. frigida* A. Gray; not Haenke) On alpine peaks and in arctic regions from Mont. and Alaska to Colo. and Utah; also Asia.—Alt. 11,000–14,000 ft.—Headwaters of Clear Creek; Gray's Peak; Gentian Ridge; Saddle Cliffs; Mt. Harvard; Alpine Tunnel; Mt. Ouray; Seven Lakes, near Pike's Peak; Georgetown; near Pagosa Peak; Dead Lake, near Pike's Peak; Devil's Causeway, White River Plateau; Cameron Pass; Berthoud Pass; Ethel Peak.

2. *Dasystephana Parryi* (Engelm.) Rydb. (*Gentiana Parryi* Engelm.) In the mountains from Wyo. to Colo. and Utah.—Alt. 8000–12,000 ft.—Trapper's Lake; Pike's Peak between Half-way House and Lake Mer; near Pagosa Peak; Westcliffe; Mt. Harvard; Artist's Glen near Pike's Peak; Georgetown; Seven Lakes; Marshall Pass; Ruxton Park; Grand Lake; Iron-ton Park, 9 miles south of Ouray; Red Mountain road, south of Ouray; Crested Butte; headwaters of Clear Creek; Red Mountain; Breckenridge; Sprague's, Estes Park; Leroux Parks, Delta Co.; Buffalo Pass; Empire; mountains between Sunshine and Ward.

3. *Dasystephana affinis* (Griseb.) Rydb. (*Gentiana affinis* Griseb.) In the mountain meadows from Sask. and Alb. to Colo.—Alt. 7000–12,000 ft.—Mountain meadows, Twin Lakes; Sand Creek Pass; Pike's Peak; Trail Glen; Crystal Park; Lake John, North Park; Colorado Springs; headwaters of Clear Creek, near Empire; between Porter and Durango; Sprague's, Estes Park; Medicine Bow Mountains.

4. *Dasystephana Forwoodii* (A. Gray) Rydb. (*Gentiana Forwoodii* A. Gray) On hills from Alb. to Colo.—Alt. 7000–10,000 ft.—Gray's Peak; Sargent; Westcliffe; Twin Lakes; headwaters of Clear Creek near Empire; Pearl; Wolcott; Gunnison; Mt. Harvard; Lake City; Buena Vista; Gypsum Creek Cañon.

5. *Dasystephana Bigelovii* (A. Gray) Rydb. (*Gentiana Bigelovii* A. Gray) In the mountains from Colo. to N. M. and Ariz.—Alt. about 6000 ft.—Colorado Springs; Pike's Peak; Sprague's; Estes Park; west of Soldier Cañon.

6. *Dasystephana interrupta* (Greene) Rydb. (*Gentiana interrupta* Greene) In the mountains from Colo. to Nev.—Alt. about 8000 ft.—Kremmling; Pagosa Springs; Parlin, Gunnison Co.

7. PLEUROGYNE Eschsch.

1. *Pleurogyne fontana* A. Nels. (*P. rotata* Hook., in part; not Griseb.; *P. rotata tenuifolia* Griseb.) In damp places from Hudson Bay and Alaska to Colo.—Alt. 8000–11,000 ft.—Twin Lakes; near Lake John, North Park; Jefferson, South Park; Caribou; headwaters of Clear Creek, near Empire; Beaver Creek.

8. SWERTIA L.

Flowers 4-merous.

Flowers 5-merous.

Inflorescence elongated; corolla-lobes linear or oblong.

Inflorescence congested; corolla-lobes oval-elliptic.

1. *S. scopulina*.

2. *S. palustris*.

3. *S. congesta*.

1. *Swertia scopulina* Greene. In mountain meadows of Colo.—Alt. about 10,000 ft.—Keblar Pass.

2. *Swertia palustris* A. Nels. (*S. perennis* Am. auth.; not L.) In wet places from Mont. to Colo. and Utah.—Alt. 8000–13,000 ft.—Pike's Peak; near Pagosa Peak; Stephen's Mine; 4 miles west of Cameron Pass; Crested Butte; Marshall Pass; near Ironton, San Juan Co.; Clear Lake; Gray's Peak; Artist's Glen near Pike's Peak; Georgetown; Hamor's Lake above Durango; Alpine Tunnel; Mt. Harvard; Ruxton Dell; above timber line, Silver Plume; Breckenridge; headwaters of Clear Creek; Ragged Mountain, Gunnison Co.; Georgetown; Berthoud Pass; Buffalo Pass.

3. *Swertia congesta* A. Nels. In wet places in the alpine regions from Mont. to Colo. and Utah.—Alt. about 12,000 ft.—Seven Lakes.

9. FRASERA Walt.

Petals about 2 cm. long, usually exceeded by the long sepals.

Plant glabrous; inflorescence simple with verticillate pedicels; basal leaves over 1 dm. wide.

1. *F. macrophylla*.

Plant puberulent; inflorescence compound; some branches simple, others again branched; basal leaves about 5 cm. wide.

2. *F. scabra*.

Petals about 15 mm. long or less; inflorescence compound.

Sepals narrowly linear, usually much exceeding the petals; floral leaves narrowly linear-lanceolate, very long.

3. *F. stenosepala*.

Sepals linear-lanceolate, scarcely equalling the petals; floral leaves similar to the upper stem-leaves, but smaller and narrower.

Stem-leaves oblanceolate.

4. *F. speciosa*.

Stem-leaves linear-lanceolate.

5. *F. angustifolia*.

1. *Frasera macrophylla* Greene. On hills from Wyo. to Colo. and Utah.—Alt. 9000–10,000 ft.—Pagosa Springs; Keblar Pass; Ironton Park, 9 miles south of Ouray.

2. *Frasera scabra* (Jones) Rydb. (*F. speciosa scabra* Jones) On hills from Colo. to Ariz.—Alt. 8000–10,000 ft.—Bob Creek, West La Plata Mountains; Abiqua Peak.

3. *Frasera stenosepala* Rydb. On the hills from Wyo. to N. Mex.—Alt. 6000–9500 ft.—Foot-hills, Larimer Co.; Ward, Boulder Co.; The Craggs, Pike's Peak; headwaters of Clear Creek, near Empire; Pike's Peak trail.

4. *Frasera speciosa* Dougl. On hills from S. D., Mont. and Ore. to Colo. and Calif.—Alt. 7000–10,000 ft.—Sand Creek Pass; Manitou; Mt. Abram, Ouray; Cheyenne Mountain; Howe's Gulch; Bosworth's ranch, Stove Prairie; gulch west of Pennock's; Rist Cañon; Horsetooth Gulch; Ute Pass.

5. *Frasera angustifolia* Rydb. On dry hills from Mont. to Colo.—Mountains between Sunshine and Ward.

Family 108. MENYANTHACEAE G. Don. BUCKBEAN FAMILY.

1. MENYANTHES L. BUCKBEAN, MARSH TRIFOIL.

1. *Menyanthes trifoliata* L. In water from Greenl. and Alaska to Pa. and Calif.; also in Europe and Asia.—Estes Park, Larimer Co.

Order 43. ASCLEPIADALES.

Styles united; stamens distinct or gynandrous; pollen loosely granular.

Styles distinct; stamens monadelphous; pollen united into waxy masses or the grains in groups of 4.

109. APOCYNACEAE.

110. ASCLEPIADACEAE.

Family 109. APOCYNACEAE Lindl. DOGBANE FAMILY.

Anthers unappendaged at the base, not connected with the stigma; flowers without a disk; leaves alternate.

1. AMSONIA.

Anthers appendaged at the base, converging around the stigma and slightly adhering to it; calyx-tube partly attached to the gynoeceum by the thick disk; leaves opposite.

2. APOCYNUM.

1. AMSONIA Walt.

1. *Amsonia texana* (A. Gray) Heller. (*A. angustifolia texana* A. Gray)

In rocky places from Texas to Colo.—Grand Junction.

2. APOCYNUM L. DOGBONE, INDIAN HEMP.

Corolla fully twice as long as the calyx; its lobes spreading in anthesis.

Leaves more or less pubescent beneath.

Sepals broadly lanceolate; corolla open campanulate; leaves thick, dark green, decidedly pubescent beneath.

Leaves oval, acute at both ends; plant usually tall.

1. *A. androsemaefolium*.

Leaves more or less ovate, rounded, truncate, or cordate at the base; plant low, diffuse.

2. *A. scopulorum*.

Sepals narrowly lanceolate; corolla narrower, almost cylindro-campanulate; leaves pale green, pubescent merely on the petioles and the veins beneath, the lower truncate, the upper acute at the base.

3. *A. lividum*.

Leaves perfectly glabrous.

4. *A. ambigens*.

Corolla less than twice as long as the calyx; its lobes erect or nearly so.

Leaves acute at the base, petioled.

5. *A. cannabinum*.

Leaves, at least those of the main stem, truncate or subcordate at the base and sessile.

6. *A. hypericifolium*.

1. *Apocynum androsemaefolium* L. In copses and borders of woods from Anticosti and Ida. to Ga. and Ariz.—Alt. 7000–9500 ft.—Artist's Glen; Engelmann Cañon; Wahatoya Creek; mountains, Larimer Co.; Stove Prairie Hill; Horsetooth.

2. *Apocynum scopulorum* Greene. In the mountains from Sask. and Yukon to Colo.—Alt. 5000–9000 ft.—Pagosa Springs; Mancos; Roger's, Gunnison watershed.

3. *Apocynum lividum* Greene. In the mountains of Colo.—Alt. 5000–8000 ft.—Black Cañon; mouth of Cheyenne Cañon; Mancos; Piedra; Palisade; Clear Creek Cañon; Ft. Collins.

4. *Apocynum ambigens* Greene. In the mountains from Mont. and Wash. to Colo. and Calif.—Alt. 6000–9000 ft.—West of Ouray; Black Cañon; Boulder Cañon; Rist Cañon; Horsetooth Mountain; Montrose; Steamboat Springs.

5. *Apocynum cannabinum* L. On banks of streams from Anticosti and Wash. to Fla. and L. Calif.—Alt. 4000–5000 ft.—Deer River; New Windsor, Weld Co.; Boulder; along the Poudre; Ft. Collins.

6. *Apocynum hypericifolium* Ait. In sandy soil from Ont. and B. C. to Ohio and N. M.—Alt. 5000–6000 ft.—Plains and foot-hills near Boulder.

Family 110. **ASCLEPIADACEAE** Lindl. MILKWEED FAMILY.

Corolla-lobes reflexed during anthesis.

Hoods of the crown crestless within or with an obscure crest-like midrib.

1. *ACERATES*.

Hoods of the crown each with a horn-like process within.

2. *ASCLEPIAS*.

Corolla-lobes erect-spreading during anthesis; hoods with a crest at least above.

3. *ASCLEPIODORA*.

1. **ACERATES** Ell. GREEN MILKWEED.

Auricles of the hood, when present, concealed within; leaves oval to linear-lanceolate.

1. *A. viridiflora*.

Auricles of the hoods conspicuously spreading; umbels lateral; leaves narrowly linear.

Hoods emarginate or truncate at the summit, crestless within; umbels distinctly peduncled.

2. *A. auriculata*.

Hoods trilobed at the summit with an internal crest-like midrib terminating in the middle lobe; umbels subsessile or on very short peduncles.

3. *A. angustifolia*.

1. *Acerates viridiflora* (Raf.) Eat. In dry or sandy soil from Mass. and Mont. to Fla. and N. M.—Alt. 4000-6000 ft.—Fossil Creek, Larimer Co.; Horsetooth Mountain; Boulder; Berkeley; Valverde.

2. *Acerates auriculata* Engelm. On dry plains from Neb. and Colo. to Tex. and N. M.—Alt. 4000-5000 ft.—Cañon City; Ft. Collins; Horsetooth Gulch; Denver; Valverde; Montclair.

3. *Acerates angustifolia* (Nutt.) Decaisne. (*Asclepias stenophylla* A. Gray) In sandy soil from S. D. and Colo. to Mo., Tex. and N. M.—Exact locality not given.

2. **ASCLEPIAS** L. MILKWEED, SILKWEED.

Leaves orbicular to linear-lanceolate, opposite.

Follicles with soft spinulose processes, tomentose; leaves large and broad, tomentose, transversely veined, oval or ovate.

1. *A. speciosa*.

Follicles without processes.

Flowers very large; petals over 1 cm. long; column none; horns included in the hoods; leaves almost orbicular, subcordate at the base.

2. *A. cryptoceras*.

Flowers middle-sized or small; petals much less than 1 cm. long; column usually present and horns exserted.

Leaves broadly oval or rectangular oval or nearly orbicular, obtuse or retuse at both ends; umbels sessile.

Plant puberulent when young, glabrate in age; column very short.

3. *A. latifolia*.

Plant tomentulose; column half as long as the anthers.

4. *A. arenaria*.

Leaves ovate or lanceolate, or rarely oval, acute.

Leaves ovate or ovate-lanceolate, more or less tomentose at least when young; hoods ovate-oblong to lanceolate, much exceeding the stamens.

5. *A. Hallii*.

Leaves linear-lanceolate; hoods truncate, little if any longer than the anthers.

Column short; leaves pale, tomentose or puberulent when young.

Hoods about half as long as the anthers; umbels peduncled.

6. *A. brachystephana*.

Hoods only slightly shorter than the anthers; umbels subsessile.

7. *A. uncinialis*.

Column more than half as long as the anthers; corolla purple; leaves glabrous.

8. *A. incarnata*.

Leaves narrowly linear, verticillate or scattered.

Plant tall, 4-6 dm. high from a rootstock; leaves verticillate.

Hoods entire.

Hoods dorsally hastate-sagittate.

Plant low, 1-2 dm. high, bushy from a ligneous base; leaves scattered.

9. *A. verticillata*.

10. *A. galioides*.

11. *A. pumila*.

1. *Asclepias speciosa* Torr. On river bottoms and in fields from Man. and B. C. to N. M. and Calif.—Alt. 4000-8000 ft.—Ft. Collins; Mancos; Denver; Wahatoya Cañon; Piedra; Colorado Springs; Grand Junction; Boulder.

2. *Asclepias cryptoceras* S. Wats. In dry soil from Ida. and Ore. to Colo.—Grand Junction.

3. *Asclepias latifolia* (Torr.) Raf. (*A. obtusifolia latifolia* Torr.; *A. Jamesii* Torr.) On plains from Colo. to Tex. and Ariz.—Hotchkiss; Cañon City.

4. *Asclepias arenaria* Torr. In sandy soil from Neb. and Colo. to Okl. and N. M.—Locality not given.

5. *Asclepias Hallii* A. Gray. In gravelly soil in Colo.—Alt. 7000-9000 ft.—Calhan; Veta Pass; Gunnison; La Veta; Buena Vista; Arkansas River.

6. *Asclepias brachystephana* Engelm. In sandy soil from Wyo. to Tex. and Ariz.—“On the plains.”

7. *Asclepias uncialis* Greene. In sandy soil from Wyo. to N. M. and Ariz.—“Colorado” (*Hall & Harbour*).

8. *Asclepias incarnata* L. In swamps and wet meadows from N. B. and Man. to Fla. and N. M.—Alt. 4000-6000 ft.—Ft. Collins; Timnath, Larimer Co.; Denver; Cache la Poudre; Boulder.

9. *Asclepias verticillata* L. In dry fields and on hills from Me. and N. D. to Fla. and Ariz.—Rocky Ford; Paonia; Colorado Springs.

10. *Asclepias galioides* H. B. K. In dry soil from Kans. and Colo. to Ark. and Ariz.; also Mex.—Exact locality not given.

11. *Asclepias pumila* (A. Gray) Vail. (*A. verticillata pumila* A. Gray) Dry plains and in sandy soil from S. D. and Mont. to Ark. and N. M.—Alt. 4000-7000 ft.—Near Ft. Collins; East Park, Denver; headwaters of Clear Creek; Boulder; Colorado Springs; along Platte River, Denver; Ft. Collins; Manitou; gulch, Soldier Cañon; Boulder.

3. ASCLEPIODORA A. Gray.

1. *Asclepiodora decumbens* (Nutt.) A. Gray. In dry sandy soil from Kans. and Nev. to Ark., Tex. and Ariz.; also Mex.—Alt. 7000-8000 ft.—Near Badito, between La Veta and Gardner; Arboles; Hortense Springs; Durango; Walsenburg; Dolores.

Order 44. POLEMONIALES.

Stamens 5, if only 4, not didynamous.

Fruit a capsule or berry; ovary not 4-lobed.

Styles or stigmas usually distinct.

Parasitic twining plants with scale-like leaves.

Plants not parasitic; leaves normal.

Inflorescence not scorpioid; flowers cymose or solitary; ovary 2-3-celled; micropyle of the seed turned downward.

III. CUSCUTACEAE.

Corolla plaited and the plaits convolute in the bud; flowers axillary, solitary or cymose-conglomerate; plants usually twining.

112. CONVULVULACEAE.

Corolla merely convolute in the bud, not plaited; flowers cymose; plants never twining.

113. POLEMONIACEAE.

Inflorescence more or less distinctly scorpioid; ovary in ours 1-celled or imperfectly 2-celled; micropyle of the seed turned upwards.

114. HYDROLEACEAE.

Styles and stigmas wholly united.

Ovules few.

112. CONVULVULACEAE.

Ovules numerous.

Median axis of the gynoecium in the same plane as the axis of the stem; seeds mostly pitted.

119. SOLANACEAE.

Median axis of the gynoecium not in the same plane as the axis of the stem; seed tuberculated (*Verbascum*).

120. RHINANTHACEAE.

Fruit of 1-4 nutlets (in all our genera); ovary more or less distinctly 4-lobed.

Style or stigma furnished with a glandular ring.

115. HELIOTROPACEAE.

Style or stigma not furnished with a glandular ring.

116. BORAGINACEAE.

Stamens 4 and didynamous, or 2 or 1.

Carpels ripening into 4 nutlets, an achene or a drupe.

Style apical on the lobeless ovary.

117. VERBENACEAE.

Style arising between the 4 lobes of the ovary.

118. LAMINACEAE.

Carpels ripening into a capsule.

Placentae of the ovary axile.

Ovary 2-celled, rarely 3-5-celled; land-plants.

120. RHINANTHACEAE.

Ovary 1-celled; ours submerged water-plants.

121. PINGUICULACEAE.

Placentae of the ovary parietal.

Herbs parasitic on the roots of other plants; leaves scale-like, not green.

122. OROBANCHACEAE.

Herbs with green leaves; not parasitic.

123. MARTYNIACEAE.

Family 111. CUSCUTACEAE Dumont. DODDER FAMILY.

1. CUSCUTA L. DODDER.

Styles equal with elongated stigmas.

1. *C. epithymum*.

Styles unequal; stigma capitate.

Capsules circumscissile; calyx- and corolla-lobes acuminate; inflorescence umbel-like.

2. *C. umbellata*.

Capsule indehiscent or bursting irregularly.

Calyx gamosepalous, usually not bracted.

Corolla-lobes not incurved.

Scales of the corolla incurved upon the ovary; styles about half as long as the ovary or longer.

3. *C. Gronovii*.

Scales of the corolla appressed to the corolla-tube; styles $\frac{1}{4}$ - $\frac{1}{2}$ as long as the ovary.

4. *C. curta*.

Corolla-lobes incurved at the apex.

Capsule 4 mm. or less broad; inflorescence rather open.

5. *C. indecora*.

Capsule 5-6 mm. broad; inflorescence globular clusters.

6. *C. megalocarpa*.

Calyx of 5 almost distinct and overlapping sepals, subtended by 2 or more similar bracts.

7. *C. cuspidata*.

1. *Cuscuta epithymum* L. On clover, alfalfa, etc.; introduced from Europe.—Ft. Collins.

2. *Cuscuta umbellata* H. B. K. On low herbs, especially on *Portulaca*, from Colo. to Tex. and Ariz.; also in Mex.—Hovenweep Cañon (*Brandege*).

3. *Cuscuta Gronovii* Willd. On low shrubs and coarse herbs from N. S. and Man. to Fla., Tex. and Colo.—Manitou.

4. *Cuscuta curta* Engelm. (*C. Gronovii curta* Engelm.) On coarse herbs in sandy soil in Utah and Colo.—Alt. about 7000 ft.—Dome Rock in Platte Cañon.

5. *Cuscuta indecora* Choisy. On herbs, mostly composites and leguminous plants, commonest on *Ambrosia artemisiaefolia* and *Glycyrrhiza lepiota*; from Ills. and Neb. to Fla. and Calif.—Alt. 4000–5000 ft.—Ft. Collins.

6. *Cuscuta megalocarpa* Rydb. On willows; in Colo. and Wyo.—Alt. about 7000 ft.—Cucharas Creek near La Veta.

7. *Cuscuta cuspidata* Engelm. On *Ambrosia*, *Iva* and some leguminous plants from Mo. and Neb. to Tex. and Colo.—Alt. 4000–5000 ft.—Ft. Collins.

Family 112. CONVULVULACEAE Vent. MORNING-GLORY FAMILY.

Styles distinct, each 2-cleft.

1. EVOLVULUS.

Styles united up to the stigmas.

Stigmas ovoid or subglobose.

2. IPOMOEA.

Stigmas filiform to oblong-cylindric.

3. CONVULVULUS.

1. EVOLVULUS L.

1. *Evolvulus Nuttallianus* R. & S. (*E. argenteus* Pursh; not R. Br.; *E. pilosus* Nutt.; not Lam.) In sandy soils and on sterile plains from S. D. and Colo. to Tex. and Ariz.; also Mex.—Alt. 4000–6000 ft.—Cañon City; along Platte River, Denver; Fossil Creek, Larimer Co.; Trinidad; Ft. Collins; near Boulder; Ouray; Dixon Cañon.

2. IPOMOEA L. MORNING-GLORY.

1. *Ipomoea leptophylla* Torr. On plains and hillsides from S. D. and Wyo. to Tex. and N. M.—Alt. 4000–5000 ft.—Denver; Rocky Ford; bank of Arkansas River.

3. CONVULVULUS L. WILD MORNING-GLORY, BINDWEED.

Bracts small, remote from the calyx.

Plant not canescent; leaf-blades hastate, but otherwise entire.

Whole plant glabrous or nearly so.

1. *C. arvensis*.

Stem and lower surface of the leaves with scattered long hairs.

2. *C. ambigens*.

Plant more or less canescent; leaves usually lobed or dissected.

Main divisions of the leaf-blades ovate or oblong, obtuse, lobed.

3. *C. hermannioides*.

Main divisions of the leaf-blades linear, entire; the basal lobes usually cleft deeply.

4. *C. incanus*.

Bracts large, close under the calyx and enclosing it.

Leaf-blades hastate; the basal lobes often sinuate-dentate, acute; stem and leaves glabrous or slightly hairy.

5. *C. americanus*.

Leaf-blades more sagittate; basal lobes rounded, entire; stem and leaves densely pubescent.

6. *C. interior*.

1. *Convolvulus arvensis* L. Naturalized from Europe, growing in fields and waste places from N. S. and Mont. to N. J. and Colo.—Durango.

2. *Convolvulus ambigens* House. In loose or sandy soil from Colo. to N. M. and Calif.—Alt. 5000–6000 ft.—Plains near Boulder; Ft. Collins.

3. *Convolvulus hermannioides* A. Gray. Dry plains and in sandy soil from Neb. and Colo. to Tex.—Trinidad.

4. *Convolvulus incanus* Vahl. On dry plains from Colo. to Tex. and Ariz.; also Mex.—Alt. 4000-5500 ft.—Cañon City; Brantly Cañon, Las Animas Co.; Trinidad.

5. *Convolvulus americanus* (Sims) Greene. (*C. sepium americanus* Sims) Among bushes from N. S. and Wash. to N. C. and N. M.—Alt. 4000-7000 ft.—Walsenburg; Cucharas Valley near La Veta; Colorado Springs; Denver; Ouray; Ft. Collins.

6. *Convolvulus interior* House. In sandy soil from Neb. and Colo. to Ind. Terr. and Ariz.—Ft. Collins.

Family 113. POLEMONIACEAE Vent. PHLOX FAMILY.

Calyx at length ruptured by the maturing capsule.

Calyx-tube more or less scarious between the lobes distended and then ruptured by the capsule.

Corolla strictly salver-shaped with a narrow throat; leaves proper opposite; seeds without spiracles.

Seeds not altered when wetted; our species all perennials with all the leaves opposite.

1. PHLOX.

Seeds mucilaginous when wetted; annuals with floral leaves alternate.

2. MICROSTERIS.

Corolla funnelform or tubular with an open funnelform throat; seeds mucilaginous when wetted.

Stem leafy; bracts not connate.

Leaves opposite; inflorescence cymose and dichotomously branched; seeds without spiracles.

3. LINANTHUS.

Leaves alternate; inflorescence paniculate or capitate; seeds usually producing spiracles (spirally twisted threads) when wetted.

4. GILIA.

Stem without proper leaves, but with persistent connate cotyledons; bracts of the capitate inflorescence leaf-like and connate at the base.

5. GYMNOSTERIS.

Calyx-tube not at all scarious, early splitting without being distended; lobes and leaves more or less spinulose-pointed; seeds without both spiracles and mucilage.

6. LEPTODACTYLOX.

Calyx not ruptured by the capsule; leaves alternate; seeds with mucilage and spiracles when wetted.

Calyx-teeth spinulose-tipped; leaves pinnatifid; flowers capitate.

7. NAVARRETTIA.

Calyx-teeth herbaceous, not spinulose-tipped.

Stamens straight; leaves simple, in ours entire.

8. COLLOMIA.

Stamens declined; leaves pinnate.

9. POLEMONIUM.

1. PHLOX L. PHLOX.

Intercostal portion of the calyx not replicate.

Leaves beset with cob-webby hairs; plants densely pulvinate-cespitose.

Leaves ovate to lanceolate, densely arachnoid-lanate, mucronate-tipped, but scarcely acerose.

1. *P. bryoides*.

Leaves subulate, acerose, sparsely arachnoid.

2. *P. canescens*.

Leaves not cob-webby, except sometimes slightly so at the base.

Leaves glabrous, or merely cob-webby at the base, not glandulose.

Calyx over 8 mm. long; its teeth longer than the tube.

Calyx and the bases of the leaves arachnoid-hairy.

3. *P. andicola*.

Calyx and stem finely villous or glabrous; leaves not arachnoid.

- Calyx over 1 cm. long; leaves flat; margins not revolute; stem 5-10 cm. high. 4. *P. multiflora*.
 Calyx less than 1 cm. long; leaves very narrow with revolute margins. 5. *P. depressa*.
 Calyx less than 8 mm. long; its lobes much shorter than the tube. 6. *P. scleranthifolia*.
 Leaves hispid-ciliate on the margin, usually with more or less glandular hairs. Leaves linear to subulate, not with thickened margins.
 Leaves less than 1 cm. long; plant densely pulvinate-cespitose; limb of corolla seldom over 1 cm. broad. Leaves almost erect, appressed; corolla-limb 6-8 mm. wide. 7. *P. condensata*.
 Leaves ascending-spreading; corolla-limb about 10 mm. wide. 8. *P. caespitosa*.
 Leaves over 1 cm. long; plant cespitose, but not pulvinate; corolla-limb 12-20 mm. wide. 9. *P. Kelseyi*.
 Leaves oblong or broadly linear with a more or less thickened and cartilaginous margin. Leaves linear, 1-2 cm. long; margins not very thick; corolla-tube twice as long as the calyx; young stems white-angled. 9. *P. Kelseyi*.
 Leaves oblong with very thick margins, 7-12 mm. long; corolla-tube not twice as long as the calyx; young stems not white-angled. 10. *P. alyssifolia*.
 Intercostal portion of the calyx replicate. Leaves long-attenuate, not thick; only upper portion of the plant glandular; corolla scarcely twice as long as the calyx. 11. *P. longifolia*.
 Leaves obtusish or abruptly acute, thick and firm; corolla-tube fully twice as long as the calyx; plant conspicuously glandular. 12. *P. Stansburyi*.
1. *Phlox bryoides* Nutt. On dry hills from Neb. and Wyo. to Colo. and Utah.—Livermore, Larimer Co.
 2. *Phlox canescens* T. & G. On dry hills from Mont. to Colo. and Calif.—Colorado, according to Gray, but doubtful.
 3. *Phlox andicola* Nutt. In sandy soil and on hills from S. D. and Ida. to Colo.—Pike's Peak; Ouray.
 4. *Phlox multiflora* A. Nelson. In the mountains from Mont. to Colo.—Alt. 5000-10,000 ft.—North Boulder Peak; mountain near Veta Pass; Jack's Cabin, Gunnison watershed; Columbine; west of Ft. Collins; Rist Cañon; North Park; Minturn; Beaver Creek.
 5. *Phlox depressa* (E. Nels.) Rydb. (*Phlox multiflora depressa* E. Nels.) In the mountains from Mont. and Ida. to Colo.—"Colorado."
 6. *Phlox scleranthifolia* Rydb. On mountain sides from S. D. and Mont. to Colo.—Alt. 10,000-13,000 ft.—West Spanish Peak.
 7. *Phlox condensata* (A. Gray) E. Nelson. (*P. caespitosa condensata* A. Gray) In the mountains of Colo.—Alt. 12,000-13,000 ft.—Uncompahgre Peak; headwaters of Clear Creek; Sierra Blanca; mountains above Como; Alpine Tunnel; northwest of Como; Boreas.
 8. *Phlox caespitosa* Nutt. On rocky hills and mountains from Mont. and B. C. to Colo. and Ore.—Alt. 10,000-13,000 ft.—West Spanish Peak; Mt. Hesperus; northwest of Como.
 9. *Phlox Kelseyi* Britton. In valleys from N. D. and Mont. to Colo.—Alt. up to 12,000 ft.—Little Kate Basin, La Plata Mountains.
 10. *Phlox alyssifolia* Greene. On hills from S. D. and Ass. to Colo.—Exact locality not given (*Hall & Harbour*).

11. *Phlox longifolia* Nutt. In valleys and on hills from Mont. and Wash. to Colo. and Ore.—Mancos; Leroux Creek, Delta Co.; Palisade, Mesa Co.; Minturn.

12. *Phlox Stansburyi* (Torr.) Heller. (*P. speciosa Stansburyi* Torr.) In dry regions from Colo. to N. M. and Calif.—Alt. 7000–8000 ft.—Los Pinos (Bayfield); Middle Park; Cerro Summit; Mancos; Hotchkiss; Cimarron; Palisades; Dolores.

2. MICROSTERIS Greene.

1. *Microsteris micrantha* (Kellogg) Greene. (*Collomia micrantha* Kellogg; *C. gracilis* A. Gray, in part) In sandy soil from Neb. and Wyo. to Colo. and Calif.—Alt. 4000–9000 ft.—Los Pinos (Bayfield); Veta Pass; headwaters of Sangre de Cristo Creek; west of Ft. Collins; southeast of La Veta; Mancos Cañon; Cedar Edge, Gunnison watershed; near Denver; Horsetooth Gulch; gulch west of Soldier Cañon; Trinidad; Boulder; Buena Vista.

3. LINANTHUS Benth.

1. *Linanthus Harknessii* (Curran) Greene. (*Gilia Harknessii* Curran; *G. pharnaceoides* A. Gray, in part) In sandy or loose soil from Mont. and B. C. to Colo. and Calif.—Middle Park; Steamboat Springs.

4. GILIA R. & P.

Flowers capitately or spicately glomerate.

Perennials; flowers in dense heads or spikes.

Leaves entire.

Leaves at least some of them pinnatifid.

Plant branched only at the base or simple; stem or branches strict, with a single head-like or spike-like inflorescence.

Inflorescence spike-like, more or less interrupted; corolla greenish-white, its lobes acute.

Inflorescence head-like; corolla white, its lobes obtuse.

Plants branched above as well as the base; inflorescence of several heads, more or less corymbosely arranged.

Corolla-lobes about 2 mm. long; calyx-teeth and bracts green with very short spine-tips; branches straw-color.

Corolla-lobes 4–5 mm. long; calyx-lobes and bracts rose-tinged with long spine-tips; stems tinged with purple.

Annuals, repeatedly branched, with small clusters of flowers in the axils of the leaves, more capitate at the ends of the branches.

Divisions of the leaves linear-filiform; floral leaves similar; corolla twice as long as the calyx.

Divisions of the leaves very short, oblong; floral leaves broader and shorter, more entire; tube of the corolla slightly exceeding the calyx.

Flowers openly paniculate or thyrsoid-paniculate.

Leaves pinnately divided.

Corolla-tube over 1 cm. long; corolla salver-form; calyx-lobes lanceolate, attenuate and spine-tipped.

Inflorescence thyrsoid, narrow.

Corolla-lobes acute or acuminate; corolla usually scarlet or pink.

Calyx only slightly scarious at the angles; its lobes lanceolate-attenuate, longer than the tube.

1. *G. sperguliifolia*.

2. *G. spicata*.

3. *G. cephaloidea*.

4. *G. iberidifolia*.

5. *G. roseata*.

6. *G. pumila*.

7. *G. polycladon*.

- Calyx and inflorescence glandular-puberulent, not long-hairy.
 8. *G. aggregata*.
- Calyx and usually also the inflorescence with long white flat hairs as well as glandular-puberulent.
 9. *G. pulchella*.
- Calyx very scarious at the angles; its teeth shorter than the tube; corolla-lobes acute.
 10. *G. scariosa*.
- Corolla-lobes rounded or obtuse at the apex; corolla white.
 11. *G. candida*.
- Inflorescence open and inclined to be flat-topped.
 Corolla-tube 3-4 cm. long; its lobes obtuse.
 12. *G. longiflora*.
- Corolla-tube 1.5-2.5 cm. long; its lobes acute.
 13. *G. laxiflora*.
- Corolla-tube less than 1 cm. long.
 Stamens exserted; corolla salverform.
 Divisions of the leaves all linear-filiform, not wider than the rachis; corolla about 1 cm. long.
 14. *G. polyantha*.
- Divisions at least of the lower leaves obovate or oblong, much broader than the rachis; corolla 5-7 mm. long.
 15. *G. pinnatifida*.
- Stamens not exserted; corolla more or less funnelform.
 Corolla 7-12 mm. long; plant leafy throughout.
 Corolla-tube distinctly exserted from the calyx; leaves mostly basal or the stem-leaves reduced.
 16. *G. sinuata*.
- Corolla-tube scarcely exserted from the calyx; plant more leafy.
 17. *G. inconspicua*.
- Corolla 4-5 mm. long.
 Plant leafy only at the base; divisions short and broad; corolla about twice as long as the calyx.
 18. *G. subcaulis*.
- Plant leafy throughout; divisions of the leaves narrow, filiform; corolla only slightly exceeding the calyx.
 19. *G. minutiflora*.
- Leaves entire or the lower ones toothed or lobed.
 Basal leaves toothed or lobed.
 Flowers 1 cm. long or more.
 Stem-leaves oblanceolate, often toothed; stem rather stout; capsule 5 mm. long, acute.
 20. *G. Crandallii*.
- Stem-leaves lanceolate-subulate, entire; stem very slender; capsule 3.5 mm. long, obtuse.
 21. *G. Haydeni*.
- Flowers less than 1 cm. long.
 22. *G. leptomeria*.
- Basal leaves entire.
 Basal leaves oblanceolate or spatulate.
 Leaves petioled; corolla much exserted.
 23. *G. pentstemonoides*.
- Leaves sessile, fleshy; corolla scarcely exserted.
 24. *G. sedifolia*.
- All leaves filiform or the lower 3-parted with filiform lobes.
 19. *G. minutiflora*.

1. *Gilia spergulfolia* Rydb. On dry hills in Wyo. and Colo. to Utah.—Arboles.

2. *Gilia spicata* Nutt. On dry hills from Neb. and Wyo. to Colo. and Utah.—Alt. 4000-10,000 ft.—Headwaters of Clear Creek; Livermore, Larimer Co.; Turkey Creek and tributaries; mesas near Pueblo; Ft. Collins; plains, Larimer Co.; Morrison; Tobe Miller's ranch; mountains between Sunshine and Ward.

3. *Gilia cephaloidea* Rydb. On dry hills from Mont. to Colo.—Alt. 11,000-12,000 ft.—Mountains above Como; above Boreas.

4. *Gilia iberidifolia* Benth. In "bad lands" and on dry hills from S. D. and Mont. to Colo. and Nev.—Alt. 5000-7500 ft.—Grand Junction; Dolores.

5. *Gilia roseata* Rydb. In arid soil, western Colo.—Grand Junction.

6. *Gilia pumila* Nutt. In dry soil from Wyo. to western Texas and Ariz.—Alt. 5000-7000 ft.—Mancos; Grand Junction; Apishpa Creek, Otero Co.

7. *Gilia polycladon* Torr. In cañons from Colo. and Nev. to W. Tex.—Alt. 4000–5000 ft.—Cañon of Grand River; Grand Junction.

8. *Gilia aggregata* (Pursh) Spreng. In open glades and on hills from B. C. and Mont. to Colo. and Utah.—Alt. 7000–9000 ft.—Black Cañon, Gunnison watershed; Larimer Co.; West Mancos Cañon; Rabbit-Ear Pass; Dolores; Medicine Bow Mountains; Dillon Cañon, Trinidad; Hotchkiss; Sherwood; Steamboat Springs; Brant's Soda Springs.

9. *Gilia pulchella* Dougl. (*G. aggregata attenuata* A. Gray) On open hills and plains from Ida. to Colo. and Utah.—Alt. 8000–9000 ft.—Middle Park; Arboles; West Indian Creek; Grizzly Creek; Pinkham Creek; Rabbit-Ear Range, Routt Co.

10. *Gilia scariosa* Rydb. On open hills in Colo.—Alt. 7000–9000 ft.—Headwaters of Clear Creek near Empire; Pike's Peak; Grizzly Creek; Garden of the Gods; Grayback mining camps and Placer Gulch; Minnehaha, Pike's Peak; Veta Pass; Mancos Cañon; divide between Colorado Springs and Denver; Empire; Table Rock; Denver; Palmer Lake.

11. *Gilia candida* Rydb. In open valleys of Colo.—Alt. 8000–10,000 ft.—South Boulder Peak; Calhan; Veta Pass; Colorado Springs; mountains between Sunshine and Ward.

12. *Gilia longiflora* Don. In sandy soil and on plains from Neb. and Colo. to Tex. and Ariz.; also Mex.—Alt. 4000–5000 ft.—Sterling, Logan Co.; Alamosa; Ft. Collins; Pike's Peak; Salida.

13. *Gilia laxiflora* (Coul.) Osterh. (*G. longiflora laxiflora* Coul.) On plains from Colo. and Utah to N. M.—Alt. 5000–7000 ft.—New Windsor; Denver; Walsenburg; Cucharas Valley, near La Veta; Trinidad; Ft. Collins.

14. *Gilia polyantha* Rydb. (*G. exserta* A. Nels.) In dry places, in Colo.—Pagosa Springs; Hotchkiss, Delta Co.

15. *Gilia pinnatifida* Nutt. In sandy soil from Neb. and Wyo. to N. M.—Alt. 4000–14,000 ft.—Headwaters of Clear Creek; Cheyenne Cañon, near Pike's Peak; Colorado Springs; Georgetown; Sangre de Cristo Creek; Indian Creek Pass; Middle Park; Calhan; Manitou; Boulder; cañon of the Cache la Poudre; west of Ouray; Mt. Harvard; Uncompahgre River near Ouray; Pike's Peak; Ouray; Colorado Springs; Marshall Pass; Gunnison; below Carson; Boreas; Palmer Lake; Manitou Junction; Table Rock; forks of Poudre and Big South; mountains between Sunshine and Ward; Boulder.

16. *Gilia sinuata* Benth. In sandy soil from Colo. to N. M. and Calif.—Alt. 5000–6000 ft.—Walsenburg; Arboles; foot-hills near Golden.

17. *Gilia inconspicua* Dougl. On hillsides from Colo. and Utah to Ariz.; also Mex.—Alt. 6000–8000 ft.—Butte 5 miles southwest of La Veta; Wahatoya Cañon; Crystal Creek; Larimer Co.; Rist Cañon; Horsetooth Gulch; Spring Cañon; Boulder; Palmer Lake; Hotchkiss.

18. *Gilia subacaulis* Rydb. In sandy soil from Wyo. to Colo. and Utah.—Gunnison River; Grand Cañon.

19. *Gilia minutiflora* Benth. On plains and in sandy soil, from Mont. and Ore. to Colo.—Steamboat Springs.

20. *Gilia Crandallii* Rydb. Sage plains from Colo. and Nev. to N. M.—Alt. about 7000 ft.—Durango; Mancos.

21. *Gilia Haydeni* A. Gray. Dry plains of Colo.—Plains of the Mancos; San Juan; Mesa Verde and El Late (*Brandege*).

22. *Gilia leptomeria* A. Gray. In dry soil from Colo. and Utah to N. M. and Calif.—Alt. 4000–5000 ft.—Deer Run, Gunnison watershed; Grand Junction.

23. *Gilia pentstemonoides* M. E. Jones. On rocks in Colorado.—Cimarron.

24. *Gilia sedifolia* Brand. On mountains in Colo.—Sheep Mountain, Uncompahgre Range.

5. GYMNOSTERIS Greene.

1. *Gymnosteris nudicaulis* (H. & A.) Greene. In sandy soil from Ore. to Nev. and Colo. (*Gray*).

6. LEPTODACTYLON Nutt.

Leaves alternate; stem woody throughout.

Leaves opposite; stem woody only at the base.

Leaves decidedly pungent; ovules numerous.

Leaves scarcely pungent; ovules 2–3 in each cell.

1. *L. pungens*.

2. *L. Watsonii*.

3. *L. Nuttallii*.

1. *Leptodactylon pungens* (Torr.) Nutt. (*Cantua pungens* Torr.; *Gilia pungens* Benth.) In sandy valleys and on hillsides, Mont. and Wash. to Colo. and Calif.—Alt. 6000–9000 ft.—Black Cañon; Gunnison; New Windsor, Weld Co.; mountains, Larimer Co.; Walsenburg; headwaters of Sangre de Cristo Creek; Denver.

2. *Leptodactylon Watsonii* (A. Gray) Rydb. (*Gilia Watsonii* A. Gray) Rocky hills in Utah and Colo.—Alt. up to 5000 ft.—Grand Junction; Glenwood Springs.

3. *Leptodactylon Nuttallii* (A. Gray) Rydb. (*Gilia Nuttallii* A. Gray) In the mountains from Wyo. and Wash. to Colo. and Calif.—Alt. 9000–11,000 ft.—Arkansas Junction, near Leadville; Robinson; Tennessee Pass, Lake Co.; near Pagosa Peak; Oro City; Continental Divide, Routt Co.; Rabbit-Ear Pass; La Plata Cañon; Ragged Mountain; Florence; Rabbit-Ears, Larimer Co.

7. NAVARRETIA R. & P.

1. *Navarretia minima* Nutt. In dry soil from Sask. and Wash. to Neb., Ariz. and Calif.—Alt. 4000–9000 ft.—Steamboat Springs; Bear River; Delta Co.; Hebron.

8. COLLOMIA Nutt.

1. *Collomia linearis* Nutt. In dry and sandy soil from N. D. and B. C. to Neb. and Calif.; also introduced in N. B. and N. Y.—Alt. 4000–9000 ft.—Larimer Co.; Chicken Creek, West La Plata Mountains; Mancos; North Park, near Teller; Steamboat Springs; Poverty Ridge, near Cimarron; Ward, Boulder Co.; Jack's Cañon, Gunnison watershed; divide road to Steamboat Springs; Parlin, Gunnison Co.; La Veta; Idaho Springs; Durango; headwaters of Pass Creek; Pagosa Springs; Grayback mining camps and Placer Gulch; Mt. Richtofen on the Michigan; Platte Cañon; Table Rock; the Narrows; Dolores; Rist Cañon; Horsetooth Gulch; Monument; Poudre River; Boulder.

9. **POLEMONIUM** L. JACOB'S LADDER.

Corolla campanulate; filaments with pilose appendages at the base; inflorescence usually open; leaflets never verticillate.

Low, 1-3 dm. high, caespitose; basal leaves numerous and stem-leaves few.

Stem and leaves viscid-pubescent with long flat hairs.

Calyx-lobes broadly lanceolate; pedicels in anthesis shorter than the flowers.

1. *P. scopulinum*.

Calyx-lobes narrowly lanceolate; pedicels in anthesis usually equalling or exceeding the flowers.

2. *P. delicatum*.

Stem and leaves viscid-puberulent; the latter often glabrate.

3. *P. parviflorum*.

Stem tall, leafy, usually solitary from the rootstock, 4-10 dm. high.

Inflorescence narrow, dense, thyrsoid.

Plants with a slender rootstock, not long-villous.

4. *P. occidentale*.

Plants with a woody base; stem and leaves long-villous.

9. *P. foliosissimum*.

Inflorescence open and broad.

Corolla 2 cm. high or nearly so; leaves glabrous.

5. *P. grande*.

Corolla 8-15 mm. high; leaves pubescent.

Stem and inflorescence long-villous, scarcely at all viscid.

6. *P. molle*.

Stem and inflorescence short-hairy; the latter at least distinctly viscid. Corolla over 1 cm. long; inflorescence conical or obovoid in outline; main peduncle usually exceeding the branches.

Sepals oblong-lanceolate; flowers few.

7. *P. Archebaldiae*.

Sepals lanceolate; flowers numerous.

8. *P. robustum*.

Corolla less than 1 cm. long; inflorescence flat-topped; main peduncle exceeded in length by the branches.

9. *P. foliosissimum*.

Corolla funnelform; filaments without appendages at the base; inflorescence dense, spiciform; leaflets (except in the first species) verticillate.

Corolla purple.

Leaflets not verticillate.

10. *P. speciosum*.

Leaflets more or less verticillate.

Corolla less than 2 cm. long, campanulate-funnelform with a rather broad tube.

11. *P. Grayianum*.

Corolla 2-3 cm. long, funnelform with a narrow tube.

12. *P. confertum*.

Corolla yellow, ochroleucous or greenish.

Corolla funnelform; stamens adnate to the middle of the corolla-tube.

13. *P. mellitum*.

Corolla almost tubular; stamens almost wholly adnate to the corolla-tube.

14. *P. Brandegei*.

1. *Polemonium scopulinum* Greene. (*P. humile pulchellum* A. Gray, in part) On mountain sides of Colo.—Alt. 8000-14,000 ft.—Lake City; headwaters of Clear Creek; Mt. Hesperus; Iron Mountain; Tennessee Pass, Lake Co.; Seven Lakes; Cameron Pass; Georgetown; Gray's Peak; Silverton; Mt. Abram, Ouray; Alpine Tunnel; Pike's Peak; Bob Creek; Mt. Baldy; Bottomless Pit; Cottonwood Lake; Red Mountain road, south of Ouray; Carson; near Pagosa Peak; near Ironton, San Juan Co.; Silver Plume; Grand Mesa, Gunnison watershed; above Graymont; Beaver Creek; Empire; Buffalo Pass; Eldora to Baltimore; mountains between Sunshine and Ward.

2. *Polemonium delicatum* Rydb. On high mountains in Colo. and N. M.—Alt. 10,000-12,000 ft.—Marshall Pass (?); West Spanish Peak; Silver Plume; Bob Creek; Berthoud Pass.

3. *Polemonium parviflorum* Nutt. (*P. viscosum* A. Gray, in part; not Nutt.) On hills from Mont. and Wash. to Colo. and Calif.—"Colorado."

4. *Polemonium occidentale* Greene. (*P. coeruleum* A. Gray, in part; not L.) In valleys and open woods from Ass. and Alaska to Colo. and Utah.—Alt. 6000-9000 ft.—Headwaters of Sangre de Cristo Creek; Chambers' Lake; Indian Creek Pass; Parlin, Gunnison Co.; Breckenridge; Gunnison; Ironton Park, 9 miles south of Ouray; Durango; Empire; Walden.

5. *Polemonium grande* Greene. In the mountains of Colo.—Alt. about 9000 ft.—Near Pagosa Peak.

6. *Polemonium molle* Greene. In the mountains of Colo.—Alt. 8000-9500 ft.—Piedra; near La Porte; Eldora to Baltimore.

7. *Polemonium Archebaldiae* A. Nels. Mountains of Colo.—Berwind.

8. *Polemonium robustum* Rydb. In the mountains of Colo., especially along streams.—Alt. 8000-10,000 ft.—Bob Creek, West La Plata Mountains; Keb-lar Pass; Veta Pass; Sangre de Cristo Creek; headwaters of Clear Creek at Dumont; Leroux Creek.

9. *Polemonium foliosissimum* A. Gray. In the mountains of Colo. and N. M.—Alt. 6000-11,000 ft.—Headwaters of Clear Creek; Estes Park, Larimer Co.; La Veta; Veta Pass; Oak Mesa, Delta Co.; Durango; Berthoud Pass; Empire; Willow Creek; Graymont; Sargent.

10. *Polemonium speciosum* Rydb. On the highest peaks of Colo.—Alt. about 13,000 ft.—Pike's Peak; Mt. Garfield; Gray's Peak.

11. *Polemonium Grayianum* Rydb. On the higher peaks of Colo.—Alt. 9000-13,000 ft.—Gray's Peak; Graymont; Central City.

12. *Polemonium confertum* A. Gray. On the higher mountains among rocks in Wyo. and Colo.—Alt. 9000-13,000 ft.—Mt. McClellan; Pike's Peak; Cameron Pass; Lake City; Gray's Peak; headwaters of Clear Creek; Sangre de Cristo Range; West Spanish Peak; Seven Lakes; near Pike's Peak; near Ironton, San Juan Co.; mountains above Boreas; Little Kate Basin, La Plata Mountains; Ragged Mountain; Gunnison Co.; Argentine Pass; tributaries of South Fork of Cache la Poudre River, Larimer Co.; Beaver Creek; Mt. Abram, Ouray; mountains near Mt. Harvard; Mt. Hesperus; Devil's Causeway; Graymont; Berthoud Pass; Spicer, Larimer Co.

13. *Polemonium mellitum* (A. Gray) A. Nels. (*P. confertum mellitum* A. Gray) On the higher mountains from Wyo. and Nev. to Colo.—Alt. 8000-9500 ft.—Eldora to Baltimore.

14. *Polemonium Brandegei* (A. Gray) Greene. (*Gilia Brandegei* A. Gray) On the higher peaks of Colo.—Alt. 6000-12,000 ft.—Sierra Blanca; West Spanish Peak; Big Creek Gulch, Routt Co.; mountains between Sunshine and Ward; Wagon-wheel Gap.

Family 114. HYDROLEACEAE H. B. K. WATER-LEAF FAMILY.

Ovary 1-celled; style 2-cleft; leaf-blades usually toothed, lobed or dissected.

Corolla-lobes convolute in the bud; placentae dilated.

Stamens exserted; calyx not enlarged in fruit; leaves alternate.

1. HYDROPHYLLUM.

Stamens included.

Calyx enlarged in fruit, not appendaged; leaves opposite.

2. MACROCALYX.

Calyx not much enlarged in fruit with appendages in the sinuses.

Corolla-lobes imbricated in the bud; placentae narrow.

Ovary imperfectly 2-celled; styles 2, distinct; leaf-blades entire.

3. NEMOPHILA.

4. PHACELIA.

5. MARILAUNIDIUM.

1. HYDROPHYLLUM L. WATERLEAF.

Peduncles shorter than the petioles and mostly shorter than the flower-clusters; anthers oblong.

1. *H. capitatum*.

Peduncles longer than the petioles; anthers oblong-linear.

2. *H. Fendleri*.

1. *Hydrophyllum capitatum* Dougl. In wet places on hillsides from Mont. and B. C. to Colo. and Calif.—Alt. about 9000 ft.—Grand Mesa, Gunnison watershed; Rabbit-Ear Range, Routt Co.; Steamboat Springs.

2. *Hydrophyllum Fendleri* (A. Gray) Heller. (*H. occidentale Fendleri* A. Gray) Along streams and among bushes from Wyo. and Ida. to Colo. and N. M.—Alt. 5000-10,000 ft.—West of Ft. Collins; near Pagosa Peak; Apex; Van Boxle's ranch, above Cimarron; Villa Grove; Idaho Springs; Ojo; East Indian Creek; Pass Creek; Chicken Creek, West La Plata Mountains; Horsetooth Gulch; Rist Cañon; Dixon Cañon; mountains between Sunshine and Ward; Empire.

2. MACROCALYX Trew.

1. *Macrocalyx Nyctelea* (L.) Kuntze. (*Ellisia Nyctelea* L.) In damp places from Sask. and Mont. to Va. and Colo.—Alt. 5000-9000 ft.—Ft. Collins; New Windsor, Weld Co.; Cerro Summit, Gunnison watershed; Sangre de Cristo Creek; Cucharas River below La Veta; Horsetooth Gulch; Spring Cañon.

3. NEMOPHILA Nutt.

1. *Nemophila breviflora* A. Gray. In rich soil from Mont. and Ida. to Colo. and Ore.—Steamboat Springs.

4. PHACELIA Juss.

Leaves all simple and entire or some of the lower pinnately 3-5-divided with entire divisions; capsule acute; ovules 4.

Plant densely whitish canescent.

1. *P. leucophylla*.

Plant pubescent but not canescent.

Plant decumbent or ascending, slender, 1-3 dm. high; inflorescence open with a few branches.

2. *P. alpina*.

Plant erect or sometimes ascending, 3-5 dm. high, stout and more leafy; inflorescence dense with numerous short branches.

3. *P. heterophylla*.

Leaves from sinuate-crenate to twice-pannatifid.

Plant annual, not caespitose.

Corolla-lobes entire or merely sinuate-crenate.

Leaves sinuate-crenate to lobed half-way to the midrib.

Stem-leaves ovate, oval or elliptic in outline; edges and ridge of the seeds not with cross ridges.

4. *P. integrifolia*.

Stem-leaves oblong in outline; edges and salient ventral ridge of the seeds with rounded cross-ridges.

5. *P. corrugata*.

Leaves pinnately divided to the midrib.

Terminal divisions of the leaves large and obovate in outline.

6. *P. splendens*.

Terminal divisions of the leaves not much enlarged, ovate, lanceolate or oblong in outline.

7. *P. glandulosa*.

Corolla-lobes distinctly dentate or erose.

Corolla white; stamens about twice as long as the corolla.

8. *P. alba*.

Corolla purplish or pink; stamens slightly exceeding the corolla.

9. *P. neo-mexicana*.

Plant perennial, caespitose; inflorescence spicate-thyriform.

Plant equally sericeous throughout; segments of the leaves narrowly linear.

10. *P. sericea*.

Plant finely pubescent, hirsute-ciliate on the petioles; segments of the leaves oblong.

11. *P. ciliosa*.

1. *Phacelia leucophylla* Torr. On dry hills from S. D. and Wash. to Colo. and Utah.—Alt. up to 8000 ft.—Horsetooth Gulch; mountains between Sunshine and Ward.

2. *Phacelia alpina* Rydb. On mountains from Mont. to Colo. and Nev.—Alt. 7000–12,500 ft.—Steamboat Springs; Silver Plume; Mt. Harvard; near Ironton, San Juan Co.

3. *Phacelia heterophylla* Pursh. On hills from Mont. and Wash. to Colo. and Calif.—Alt. 6000–9000 ft.—Near Empire; Ironton Park, 9 miles south of Ouray; foot-hills, Larimer Co.; Narrows, Poudre Cañon; Howe's Gulch; Dixon Cañon; gulch west of Pennock's; Horsetooth Mountain; Rist Cañon; Rabbit-Ear Range, Routt Co.; Platte River; Colorado Springs; Eldora to Baltimore; Ft. Collins; Amelia; Table Rock; Ute Pass, near Pike's Peak; Pagosa Peak; Van Boxle's ranch, above Cimarron; Ouray; Upper West Mancos Cañon; Sangre de Cristo Creek; East Indian Creek; Lake Moraine; William's Cañon, near Pike's Peak; Trail Glen; Boulder; Rist Cañon; Ragged Mountain.

4. *Phacelia integrifolia* Torr. In gypsum soil from Colo. and Utah to western Tex. and Ariz.; also Mex.—"Southwestern Colorado."

5. *Phacelia corrugata* A. Nels. In dry soil from Colo. and Utah to western Tex. and N. M.—Alt. 4000–5000 ft.—Grand Junction; Rifle, Garfield Co.; Palisade.

6. *Phacelia splendens* Eastw. In dry ground in Colo. and Utah.—Alt. 5000–8000 ft.—Ouray; Cimarron; Hotchkiss, Delta Co.; Grand Junction; Lake City.

7. *Phacelia glandulosa* Nutt. In gravelly soil from Mont. to western Tex. and Ariz.—Alt. 6000–10,000 ft.—Mt. Harvard; Cheyenne Cañon; West Spanish Peak; Walsenburg; Lake City; Cumbres; foot-hills, Larimer Co.; Howe's Gulch.

8. *Phacelia alba* Rydb. In valleys from Wyo. to N. M.—Alt. 8000–10,000 ft.—Headwaters of Clear Creek; Sangre de Cristo Creek; La Veta; Placer; Doyle's; Georgetown; Marshall Pass; Graymont; Eldora to Baltimore.

9. *Phacelia neo-mexicana* Thurber. In sandy soil from Colo. to N. M.—Alt. 4500–7500 ft.—Georgetown; between La Veta and Gardner, near Badito; Trinidad; Salida; La Porte, Larimer Co.; Dillon Cañon.

10. *Phacelia sericea* Hook. In the mountains from Mont. and B. C. to Colo. and Nev.—Alt. 9000–13,000 ft.—Lake City; mountains south of Ward, Boulder Co.; Mt. Garfield; Tennessee Pass, 7 miles west of Leadville; Leadville, Lake Co.; Mt. Harvard; Larimer Co.; Silverton; Medicine Bow Mountains; above Graymont; above Como; Beaver Creek; Larimer Co.; Eldora to Baltimore.

11. *Phacelia ciliosa* Rydb. In the mountains from Alb. and B. C. to Colo. and Nev.—Alt. 8000–12,000 ft.—Between Bald Mountain and Seven Lakes; near Pagosa Peak; Cameron Pass; Hahn's Peak; Clear Creek Cañon; mountains above Boreas; Berthoud Pass, near Georgetown; Little Kate Basin, La Plata Mountains; Carson; Silver Plume.

5. MARILAUNIDIUM Kuntze.

1. *Marilaunidium angustifolium* (A. Gray) Kuntze. (*Nama dichotomum angustifolium* A. Gray) In cultivated ground and waste places from Colo. to N. M.—Colorado Springs.

Family 115. HELIOTROPACEAE Small. HELIOTROPE FAMILY.

Cone of the stigma penicillate-setose; fruit didymous; each of the two carpels splitting into two almost hemispherical nutlets. 1. EUPLOCA.

Cone of the stigma not penicillate-setose; fruit in ours 4-lobed, splitting into four 1-seeded nutlets. 2. HELIOTROPIUM.

1. EUPLOCA Nutt.

1. *Euploca convolvulacea* Nutt. (*Heliotropium convolvulaceum* A. Gray) Sandy plains from Neb. and Wyo. to Tex. and Calif.; also Mex.—Arkansas River; sandy plains of Platte.

2. HELIOTROPIUM L. HELIOTROPE.

1. *Heliotropium spathulatum* Rydb. (*H. Curassavicum* Hook.; not L.) In river valleys from Ass. and Wash. to N. M. and Calif.—South of New Windsor, Weld Co.

Family 116. BORAGINACEAE A. Gray. BORAGE FAMILY.

Nutlets with hooked prickles at least on the margin. 1. LAPPULA.

Nutlets unarmed or if prickly, the prickles not curved.

Receptacle conic or elongated; the nutlets attached laterally.

Nutlets attached below the middle, with an oblique truncate back, which is surrounded by an entire or toothed margin; low pulvinate-cespitose perennials. 2. ERITRICHIMUM.

Nutlets attached at the middle or with an elongated scar reaching from the base to above the middle, not with a truncate margined back; plants not pulvinate-cespitose.

Pedicels and calyx persistent in fruit.

Calyx circumscissile; plants dichotomously branched. 3. PIPTOCALYX.

Calyx not circumscissile; plants not dichotomously branched.

Calyx-lobes spreading in fruit; leaves alternate; perennials. 4. OREOCARYA.

Calyx nearly closed in fruit; leaves proper opposite; annuals. 5. ALLOCARYA.

Pedicels in fruit falling off with the calyx; the latter closed; branched but not dichotomous annuals. 6. CRYPTANTHE.

Receptacle flat or merely convex.

Scar of the nutlets large and excavated, bordered by a prominent margin. 7. ANCHUSA.

Scar of the nutlets small and marginless.

Nutlets obliquely attached; flowers mostly bractless; corolla blue or white with funnelform throat.

8. *MERTENSIA*.

Nutlets attached by the very base.

Corolla salverform or funnelform; its lobes rounded and spreading.

Racemes not bracted; corolla in ours blue; its lobes convolute in bud.

9. *MYOSOTIS*.

Racemes bracted; corolla yellow or yellowish; its lobes imbricated in bud.

10. *LITHOSPERMUM*.

Corolla tubular; its lobes erect, acute, otherwise as in *Lithospermum*.

11. *ONOSMODIUM*.

1. *LAPPULA* Moench. STICK-SEED.

Inflorescence leafy-bracted only at the base; bracts minute above; gynobase short-pyramidal; scar of the nutlets ovate or triangular; perennials or biennials.

Corolla 1.5-6 mm. wide, blue; stem very leafy.

Marginal prickles free to the base or nearly so.

Corolla 1.5-3 mm. wide.

1. *L. Besseyi*.

Corolla 4-6 mm. wide (leaves firmer).

2. *L. floribunda*.

Marginal prickles united for $\frac{1}{4}$ - $\frac{1}{2}$ their length into a distinct wing.

Stem-leaves linear-lanceolate, densely strigose.

3. *L. angustata*.

Stem-leaves oblong-lanceolate, hispidulous; the hairs with papillose bases.

4. *L. scaberrima*.

Corolla 6-8 mm. wide, blue with white center; stem very leafy at the base.

5. *L. gracilentia*.

Inflorescence leafy; the floral leaves, although smaller, resembling those of the stem; annuals.

The annular margin connecting the bases of the prickles inconspicuous in all four nutlets.

Calyx-lobes more than twice as long as the fruit, reflexed-spreading; floral leaves broadly lanceolate.

6. *L. calycosa*.

Calyx-lobes less than twice as long as the fruit; floral leaves linear or linear-lanceolate.

7. *L. occidentalis*.

The annular margin connecting the bases of the prickles at least in three of the nutlets broadened and forming a cup.

Plant diffusely branched, at flowering time without basal rosette.

8. *L. cupulata*.

Plant at flowering time with a basal rosette of spatulate leaves; stems more simple.

9. *L. collina*.

1. *Lappula Besseyi* Rydb. In wooded cañons of Colorado.—Alt. about 8000 ft.—Mouth of Cheyenne Cañon near Pike's Peak.

2. *Lappula floribunda* (Lehm.) Greene. (*Echinosperrum floribundum* Lehm.) On hillsides and among bushes from Man. and Alb. to N. M. and Calif.—Alt. 5000-10,000 ft.—Boulder Cañon; New Castle; Twin Lakes; La Veta; Gunnison; Valley Spur; Pagosa Springs; near Dix Post Office; Wahatoya Creek; mountains, Larimer Co.; Four-mile Hill, Routt Co.; North Poudre; Empire; Poudre Cañon; Como.

3. *Lappula angustata* Rydb. Foot-hills of Colo. and Wyo.—Alt. 5000-6000 ft.—La Veta; foot-hills and plains near Boulder; Rist Cañon; Hahn's Peak.

4. *Lappula scaberrima* Piper. In sandy soil from Wyo. and Neb. to Colo.—Cripple Creek; Idaho Springs.

5. *Lappula gracilentia* Eastw. In cañons of southwestern Colo.—Navajo Cañon; Mesa Verde.

6. *Lappula calycosa* Rydb. In waste places and fields in Colo.—Alt. 5000-6000 ft.—Pike's Peak; Mancos; New Windsor, Weld Co.; Walsenburg; Glenwood Springs; Ft. Collins.

7. *Lappula occidentalis* (S. Wats.) Greene. (*Echinosperrum Redowskyi occidentalis* S. Wats.) In sandy places and on dry plains from Sask. and Wash. to Mo. and N. M.—Alt. 4000–10,000 ft.—Twin Lakes; mesas near Pueblo; South Cheyenne Cañon; Colorado Springs; plains near Denver; Mancos; Cimarron; river-bluffs, north of La Veta; Mountain View; Antonito; Valley Spur; along Uncompahgre River near Ouray; Los Pinos; Ft. Collins; Howe's Gulch; bank of Arkansas River; Quimby; Spring Cañon; Manitou.

8. *Lappula cupulata* (A. Gray) Rydb. In river valleys from S. D. and Ida. to Tex. and Colo.—Alt. 4000–5500 ft.—New Windsor, Weld Co.; mesas near Pueblo; Hotchkiss, Delta Co.; Cañon City; Denver; Ft. Collins.

9. *Lappula collina* Greene. On dry hills from Colo. and Utah to Tex. and Ariz.—Palisades.

2. *ERITRICHIMUM* Schrader. MOUNTAIN FORGET-ME-NOT.

Dorsal surface of the nutlets margined with a ridge-like ring, but not toothed.

1. *E. elongatum*.

Dorsal surface of the nutlets with a toothed border; corolla 4–5 mm. wide.

2. *E. argenteum*.

1. *Eritrichium elongatum* (Rydb.) White. (*E. aretioides elongatum* Rydb.) On high mountain tops from Mont. and Ore. to Colo.—Alt. 11,000–12,000 ft.—Headwaters Clear Creek; above Beaver Creek.

2. *Eritrichium argenteum* White. (*Omphalodes nana aretioides* A. Gray) On alpine peaks from Wyo. to Colo. and Utah.—Alt. 11,000–14,400 ft.—Gray's Peak; mountains above Como; mountains of Estes Park, Larimer Co.; Pike's Peak; Chicago Lake; Argentine Pass; Bald Mountain; Bush Creek, Custer Co.

3. *PIPTOCALYX* Torr.

1. *Piptocalyx circumscissa* Torr. (*Krynitzkia circumscissa* A. Gray) In dry soil from Ida. and Wash. to Colo., Ariz. and Calif.—Routt. Co., near Wyoming line.

4. *OREOCARYA* Greene.

Fruit depressed; nutlets at the margin separated by an open space.

Leaves appressed-canescant, not hispid; corolla 5–7 mm. wide.

1. *O. cinerea*.

Leaves with a fine canescence intermixed with hispid hairs; corolla less than 5 mm. wide.

Plant low, grayish, not yellowish-hispid above; racemes short, 2-ranked.

2. *O. suffruticosa*.

Plant tall, yellowish-hispid above; racemes in fruit elongated, 1-ranked.

3. *O. multicaulis*.

Fruit conical or ovoid; nutlets touching each other.

Corolla-tube not exerted.

Floral leaves long, many times longer than the short flower-clusters.

4. *O. virgata*.

Floral leaves comparatively short, little if at all surpassing the flower-clusters.

Sepals ovate-lanceolate, only slightly exceeding the mature nutlets; inflorescence a panicle with rather few branches.

Corolla 7-8 mm. broad; nutlets muricate and cross-ridged, but not honey-comb-crested.

5. *O. elata*.

Corolla 4-5 mm. broad; nutlets honey-comb-crested.

6. *O. Bakeri*.

Sepals lanceolate to linear, much exceeding the nutlets; inflorescence thyrsoïd.

Inflorescence a broad open round-topped thyrsum; branches usually again branched.

Tall, 2-4 dm. high; nutlets with acute backs and sharply acute or slightly winged margins; tubercles united into more or less distinct cross-ridges.

Plant light yellowish-green; nutlets more or less distinctly winged; cross-ridges of the nutlets rather regular and uniting on the back.

7. *O. hispidissima*.

Plants dark green; nutlets merely acute-angled and irregularly cross-ridged.

8. *O. thyrsoïflora*.

Low, 1-2 dm. high; nutlets with rounded backs and merely acutish-margined; muriculations united into almost star-shaped tubercles.

9. *O. aperta*.

Inflorescence, at least in flower, a narrow, almost spike-like thyrsum; if more open, branches simple.

Plant green, very hispid; only the basal leaves canescent; bristles with very conspicuous pustulate bases, much longer than the short strigose or tomentose pubescence.

Corolla 7-10 mm. wide; nutlets ovate, more than half as wide as long; basal leaves broadly spatulate densely canescent.

10. *O. glomerata*.

Corolla 5-7 mm. wide; nutlets lanceolate, less than half as wide as long; basal leaves broadly oblanceolate, somewhat canescent; plant 1.5-2 dm. high.

11. *O. perennis*.

Plant canescent; basal leaves at least with inconspicuous bristles, which are scarcely longer than the other pubescence; pustulate bases inconspicuous.

Plant stout, 3-4 dm. high, rather simple; corolla 7-10 mm. wide.

12. *O. argentea*.

Plant low, less than 1 dm. high, densely cespitose.

13. *O. nana*.

Corolla-tube long-exserted.

Corolla white.

Nutlets more or less distinctly rugose with irregular cross-ridges as well as muricate.

Ridges of the nutlets honey-comb-crested; inflorescence a narrow thyrsum; leaves canescent and hispid.

14. *O. eulophus*.

Ridges of the nutlets neither much interlacing nor crested.

Inflorescence at least in fruit open with elongated branches; stem stout.

15. *O. longiflora*.

Inflorescence narrow; stem slender.

16. *O. cristata*.

Nutlets finely muricate; inflorescence at last more or less yellowish; leaves finely canescent.

Plant cespitose, low, 1-1.5 dm. high; basal leaves 2-3 cm. long, 3-7 mm. wide.

17. *O. fulvocanescens*.

Plant 2-3 dm. high; basal leaves 4-8 cm. long, 7-15 mm. wide.

18. *O. nitida*.

19. *O. flava*.

Corolla yellow.

1. *Oreocarya cinerea* Greene. On dry plains of Colo.—Alt 5000-7000 ft.—Mesas near Pueblo; Cañon City; Arkansas River; Rocky Ford.

2. *Oreocarya suffruticosa* (Torr.) Greene. (*Krynitzkia Jamesii* A. Gray) On plains and foot-hills from S. D. and Wyo. to Colo.—Alt. 4000-8000 ft.—Plains and foot-hills near Boulder; Gunnison; Colorado Springs; Denver;

Salida; on the Platte; headwaters of Clear Creek; Manitou Junction; Lasalle; Morrison; Pueblo; Ouray.

3. *Oreocarya multicaulis* (Torr.) Greene. (*Eritrichium multicaule* Torr.) In arid lands from Colo. to Tex. and Ariz.—Alt. 4000-6000 ft.—Gunnison; Arboles.

4. *Oreocarya virgata* (Porter) Greene. (*Krynitzkia virgata* A. Gray) On dry hills in Wyo. and Colo.—Alt. 5000-9000 ft.—Plains and foot-hills near Boulder; Green Mountain Falls; Pike's Peak; Clear Creek Cañon; Larimer Co.; foot-hills near Golden; Ft. Collins; Manitou; headwaters of Clear Creek; Denver; Rist Cañon, Barnes' camp; Horsetooth Gulch; Soldier Cañon; North Cheyenne Cañon; Artist's Glen; Wood's ranch; Narrows.

5. *Oreocarya elata* Eastw. In arid places of western Colo.—Grand Junction.

6. *Oreocarya Bakeri* Greene. Sage plains of southern Colo.—Mancos.

7. *Oreocarya hispidissima* (Torr.) Rydb. (*Eritrichium glomeratum hispidissimum* Torr.) In river valleys and on hills from Neb. and Wyo. to N. M. and Utah.—Alt. 5000-9000 ft.—Sangre de Cristo Creek; Calloway.

8. *Oreocarya thyrsoflora* Greene. On sandy hillsides from Neb. and Wyo. to Colo.—Alt. 5000-7000 ft.—Cripple Creek; Salida; Colorado Springs; Livermore; Badito; Platte bottom.

9. *Oreocarya aperta* Eastw. On arid hills of western Colo.—Grand Junction.

10. *Oreocarya glomerata* (Pursh) Greene. (*Krynitzkia glomerata* A. Gray) Dry hills from Sask. and Ida. to Utah. It has been reported from Colorado, but doubtful.

11. *Oreocarya perennis* (A. Nels.) Rydb. (*O. affinis perennis* A. Nels.) Dry rocks from S. D. and Ida. to Colo.—Cheyenne Mountain.

12. *Oreocarya argentea* Rydb. On dry hills in Colo.—Rifle, Garfield Co.; Steamboat Springs.

13. *Oreocarya nana* Eastw. On dry table lands in western Colo.—Grand Junction.

14. *Oreocarya eulophus* Rydb. On gravelly hills in Colo. and Utah.—McCoy's, Eagle Co.; Dolores.

15. *Oreocarya longiflora* A. Nels. On dry table-lands and plains of Utah and Colo.—Alt. about 5000 ft.—Hotchkiss; Grand Junction.

16. *Oreocarya cristata* Eastw. On arid hills of western Colo.—Grand Junction.

17. *Oreocarya fulvocanescens* (A. Gray) Greene. (*Krynitzkia fulvocanescens* A. Gray) On hills from Wyo. to N. M.—Locality not given.

18. *Oreocarya nitida* Greene. On dry hills in Colo.—Alt. about 5000 ft.—Deer River; Grand Junction.

19. *Oreocarya flava* A. Nels. On hills from Wyo. to N. M. and Ariz.—Grand Junction.

5. *ALLOCARYA* Greene.

1. *Allocarya scopulorum* Greene. (*Krynitzkia californica* A. Gray, in part) In sandy soil from Mont. and Wash. to Colo. and Nev.—Alt. 5000-9000 ft.—Near Empire; Grizzly Creek; Calhan; Georgetown; Steamboat Springs, Routt Co.; Cerro Summit; Gunnison; Veta Pass; Alamosa; Hubbard Creek; Buena Vista; along the Conejos north of Antonito; Boulder; North Park.

6. *CRYPTANTHE* Lehm.

Nutlets not winged.

Nutlets dissimilar, 3 of them tubercled, the fourth smooth or nearly so.

Sepals in fruit strongly thickened on the back.

1. *C. crassisejala*.

Sepals in fruit not strongly thickened on the back.

Plant 1-2 dm. high; calyx in fruit 6-8 mm. long.

2. *C. Kelseyana*.

Plant a few cm. high; calyx in fruit less than 5 mm. long.

3. *C. minima*.

Nutlets all smooth.

Nutlets usually all four maturing.

No open areola between the forks of the groove of the acute nutlets.

4. *C. Torreyana*.

A distinct open areola between the forks of the groove of the lanceolate, acuminate nutlets.

Leaves spatulate or oblanceolate, or the upper sometimes linear.

5. *C. Pattersonii*.

Leaves narrowly linear.

6. *C. Fendleri*.

Only one nutlet maturing.

7. *C. gracilis*.

Nutlets wing-margined.

8. *C. pterocarya*.

1. *Cryptanthe crassisejala* (T. & G.) Greene. (*Krynitzkia crassisejala* A. Gray) In loose soil, "prairie-dog towns" and waste places from Sask. and Mont. to Tex. and Utah; also Mex.—Alt. 4000-6000 ft.—Walsenburg; foot-hills west of Ft. Collins; Colorado Springs; Ft. Collins; Deer River; Trinidad; New Windsor, Weld Co.; Ouray; Boulder.

2. *Cryptanthe Kelseyana* Greene. In dry and sandy soil from Ass. and Mont. to Colo.—Alt. about 6000 ft.—Pike's Peak; Walsenburg.

3. *Cryptanthe minima* Rydb. In river valleys of Colo.—Alt. about 7000 ft.—Cucharas River above La Veta.

4. *Cryptanthe Torreyana* (A. Gray) Greene. On hillsides from Ida. and Wash. to Colo. and Calif.—Idaho Springs.

5. *Cryptanthe Pattersonii* (A. Gray) Greene. (*Krynitzkia Pattersoni* A. Gray) On hillsides in Wyo. and Colo.—Alt. 6000-7000 ft.—River-bluffs north of La Veta; South Cheyenne Cañon.

6. *Cryptanthe Fendleri* (A. Gray) Greene. (*Krynitzkia Fendleri* A. Gray) In river valleys and on sandy places, from Wyo. to N. M. and Ariz.—Alt. 5000-8000 ft.—Denver; Cheyenne Mountain; Antonito; Salida; Gunnison; Colorado Springs; Palmer Lake.

7. *Cryptanthe gracilis* Osterhout. In dry soil, in Colorado.—Glenwood Springs.

8. *Cryptanthe pterocarya* (Torr.) Greene. (*Eritrichium pterocaryum* Torr.) On plains and in dry places from Wash. to N. M.—Palisades; Grand Junction.

7. *ANCHUSA* L.

1. *Anchusa officinalis* L. Introduced from Europe in waste places.—Ft. Collins.

8. *MERTENSIA* Roth. LUNGWORT.

Filaments equalling or exceeding, and usually broader than the anthers.

Calyx-lobes rounded-ovate, shorter than the ample, campanulate tube.

BRACHYLOBAE.

Calyx-lobes longer than the short tube.

Calyx-lobes linear or oblong, obtuse.

CILIATAE.

Calyx-lobes triangular-lanceolate to linear-lanceolate, acute.

Plant tall, usually over 4 dm. high; leaves distinctly veined, in most feather-veined, but in a few triple-veined with anastomosing veins.

MEMBRANACEAE.

Plant low, usually less than 4 dm. high; leaves with a strong midrib, without distinct lateral veins (except sometimes the basal leaves, which then, however, are thick and firm).

LANCEOLATAE.

Anthers subsessile or on very short narrow filaments inserted in the tube or the throat of the corolla; low plants, 1-3 dm. high, of the habit of the *lanceolata* group.

ALPINAE.

BRACHYLOBAE.

One species.

1. *M. brachyloba*.

CILIATAE.

Corolla 9-12 mm. long; limb not longer than the tube.

Sepals thickened and pale on the back.

2. *M. picta*.

Sepals neither thickened nor pale on the back.

3. *M. ciliata*.

Corolla 12-15 mm. long; limb longer than the tube.

Sepals oblong, 1.5-2 mm. long.

Leaves dark green, rough with large muricate points; pedicels with larger white murication.

4. *M. punctata*.

Leaves more glaucous, smooth or with minute callous murication; pedicels almost smooth.

5. *M. polyphylla*.

Sepals linear, 3 mm. long.

6. *M. platensis*.

MEMBRANACEAE.

Corolla 1 cm. or less long.

Corolla-tube over 4 mm. wide; calyx bristly-ciliate.

7. *M. cynoglossoides*.

Corolla-tube 2-3 mm. wide.

Plant stout; pedicels bristly hispid with spreading hairs.

8. *M. muriculata*.

Plant slender; pedicels strigose.

15. *M. viridula*.

Corolla about 1.5 cm. long.

Calyx not white-hairy, about half as long as the tube of the white corolla.

9. *M. alba*.

Calyx densely white-hairy, especially near the margins of the lobes, $\frac{1}{3}$ as long as the blue corolla.

10. *M. pratensis*.

LANCEOLATAE.

Pedicels distinctly strigose or hirsute.

Calyx and pedicels densely pubescent all over.

Stems from a more or less woody caudex or rootstock; leaves pubescent on both sides.

Leaf-blades linear or only the uppermost lanceolate.

11. *M. lateriflora*.

Blades of the basal leaves ovate, lanceolate or spatulate.

Plant more or less grayish and densely pubescent throughout, especially on the calyx.

12. *M. Bakeri*.

Plant green; pubescence long and loose, even on the stem.

13. *M. myosotifolia*.

Stems from a fusiform root; leaves glabrous beneath.

14. *M. fusiformis*.

Calyx externally glabrous except on the ciliate margins, and sometimes on the midveins and angles.

Leaves glabrous beneath.

Calyx-lobes ovate-lanceolate; inflorescence open.

15. *M. viridula*.

Calyx-lobes narrowly or linear-lanceolate; inflorescence dense.

16. *M. lineariloba*.

Leaves narrowly linear.

Leaves oblong, lanceolate to ovate.

Stem-leaves lanceolate or oblanceolate; corolla-limb about equalling the tube.

17. *M. Parryi*.

Stem-leaves ovate to ovate-lanceolate; corolla-limb shorter than the tube.

18. *M. ovata*.

Leaves hairy on both sides.

Leaves narrowly linear.

Leaves oblong or oblanceolate.

Pedicels glabrous or pustulate; calyx glabrous except the lobes.

Upper surface of the leaves short-pubescent.

Upper surface of the leaves not hairy; merely pustulate.

11. *M. lateriflora*.

19. *M. amoena*.

ciliate-margined calyx-

20. *M. linearis*.

21. *M. lanceolata*.

ALPINE.

Calyx ciliate on the margins; leaves ovate, lanceolate or oblanceolate.

Corolla 5-7 mm. long.

Corolla over 1 cm. long.

Calyx villous-ciliate all over; corolla 7-8 mm. long.

Leaves oblong or oblanceolate, glabrous beneath.

Leaves linear, densely hairy on both sides.

22. *M. alpina*.

23. *M. perplexa*.

24. *M. brevistyla*.

25. *M. canescens*.

1. *Mertensia brachyloba* Greene. On foot-hills of Colorado.—Alt. about 5500 ft.—West of Ft. Collins; Mt. Harvard.

2. *Mertensia picta* Rydb. In the mountains of Colo.—Alt. about 12,000 ft.—Mt. Baldy; Estes Park.

3. *Mertensia ciliata* (Torr.) Don. (*Pulmonaria ciliata* Torr.) Along streams from Wyo. and Ida. to Colo. and Nev.—Alt. 6000-13,000 ft.—Headwaters of Clear Creek; Pike's Peak; South Park; North Cheyenne Cañon; Colorado Springs; Cascade; Green Mountain Falls; Peak Valley; Georgetown; Gray's Peak; Boreas; Cameron Pass; Michigan Hill; Beaver Creek; Campton's Ranch; Poudre River; summit of North Park Range, Larimer Co.

4. *Mertensia punctata* Greene. Along streams in the mountains of Colo.—Alt. 9000-10,000 ft.—Near Pagosa Peak; Chambers' Lake.

5. *Mertensia polyphylla* Greene. Along streams in the mountains of Wyo. and Colo.—Alt. 8000-12,000 ft.—Near Pagosa Peak; mountains, Larimer Co.; Pike's Peak; near Iron-ton, San Juan Co.; headwaters of Pass Creek; Eldora to Baltimore; Hotchkiss; Cameron Pass; Marshall Pass; Van Boxle's ranch above Cimarron; Dark Cañon; Black Cañon; Ward, Boulder Co.; West Indian Creek.

6. *Mertensia platensis* Rydb. (*Mertensia polyphylla platensis* Rydb.) Along streams in mountains of Colo.—Alt. about 10,000 ft.—Bob Creek, West La Plata Mountains.

7. *Mertensia cynoglossoides* Greene. Along streams in Colo.—Alt. about 7000 ft.—Black Cañon.

8. *Mertensia muriculata* Greene. Along streams in Colo.—Alt. about 7000 ft.—Black Cañon.

9. *Mertensia alba* Rydb. Along mountain streams in Colo.—Alt. about 10,500 ft.—La Plata River.

10. *Mertensia pratensis* Heller. In wet meadows and along streams from Colo. to N. M. and Ariz.—Alt. 7000-12,000 ft.—Cucharas River, above La Veta; Dolores; Mt. Hesperus; Bob Creek, West La Plata Mountains; Mancos; mountains above Ouray.

11. *Mertensia lateriflora* Greene. On hillsides in Colo.—Alt. 5000-11,500 ft.—Near Empire; Ojo; Veta Mountain; Palsgrove Cañon; headwaters of Sangre de Cristo Creek; Carson; Estes Peak, Larimer Co.; South Park; Eldora to Baltimore; Estes Park; Cascade; Ruxton.

12. *Mertensia Bakeri* Greene. On the higher mountains of Colo.—Alt. 11,000-13,000 ft.—Horse-shoe Mountain; Marshall Pass; Hayden Peak; Carson; mountains above Como; Iron Mountain; Spicer.

13. *Mertensia myosotifolia* Heller. On mountains in Colo.—Red Cliff, Eagle Co.

14. *Mertensia fusiformis* Greene. (*M. congesta* Greene) On hillsides in Colo.—Alt. 7000–10,000 ft.—Graham's Peak; Bob Creek, West La Plata Mountains; Cimarron; Minturn; Poverty Ridge.

15. *Mertensia viridula* Rydb. Along mountain streams in Colo.—Alt. 6000–12,000 ft.—Jack Brook; North Cheyenne Cañon; Cascade Cañon; Colorado Springs; Ruxton; West Spanish Peak.

16. *Mertensia lineariloba* Rydb. On hillsides in Colo.—Alt. 8000–9000 ft.—West Indian Creek; near Empire.

17. *Mertensia Parryi* Rydb. On the higher mountains of Colo.—Alt. 11,000–12,000 ft.—Alpine ridges east of Middle Park; Cameron Pass; Alpine Tunnel; Estes Park; Beaver Creek; Gray's Peak; Ethel Peak.

18. *Mertensia ovata* Rydb. On high mountains among rocks in Colo.—Alt. 9000–10,000 ft.—West Spanish Peak; Anita Peak.

19. *Mertensia amoena* A. Nels. On hills in Wyo. and Colo.—Alt. 5000–10,000 ft.—Montezuma; Boulder; Eldora to Baltimore.

20. *Mertensia linearis* Greene. On dry hillsides from Ass. to Neb. and Colo.—Alt. 5000–9000 ft.—Cucharas Valley, near La Veta; Georgetown; plains near Denver; South Cheyenne Cañon, Colorado Springs; Platte Cañon; Manitou; El Paso Co.; Wahatoya Creek; near Livermore, Larimer Co.; Clear Creek Cañon; hills southeast of La Veta; Boulder; Malta station, near Leadville; Eldora to Baltimore.

21. *Mertensia lanceolata* (Pursh) DC. On hills in damp places from Mont. to Colo.—Alt. 5000–10,000 ft.—Foot-hills west of Ft. Collins; Howe's Gulch; north of La Porte; Rist Cañon; gulch west of Soldier Cañon; Eldora to Baltimore; Boulder; vicinity of Horsetooth.

22. *Mertensia alpina* (Torr.) Don. On alpine peaks of Colo.—Alt. 11,000–14,000 ft.—Massif de l'Arapahoe; Pike's Peak; headwaters of Clear Creek; Argentine Pass; Garden of the Gods; Saddle cliffs.

23. *Mertensia perplexa* Rydb. On high mountains of Colo.—Mountains south of Ward, Boulder Co.

24. *Mertensia brevistyla* S. Wats. In the mountains of Utah, Wyo. and Colo.—Exact locality not given.

25. *Mertensia canescens* Rydb. On alpine peak of Colo.—Alt. 11,000–12,000 ft.—Berthoud Pass; mountains southwest of Como.

9. MYOSOTIS L. FORGET-ME-NOT.

1. *Myosotis alpestris* Schmidt. In mountain meadows from Alb. and Alaska to Colo.—Devil's Causeway.

10. LITHOSPERMUM L. GROMWELL, PUCCOON.

Corolla-lobes neither fimbriate nor toothed; flowers all well developed.

Corolla greenish or pale yellow, 1 cm. or less long; crest in the throat obsolete.

Corolla-limb 3–5 mm. wide; tube not longer than the calyx; stem grayish strigose, but scarcely hispid.

Corolla-limb 5–8 mm. wide; tube longer than the calyx; stem more or less hispid.

1. *L. Torreyi*.

2. *L. pilosum*.

Corolla bright yellow or orange, 12 mm. or more long; crest of the tube prominent.

Floral leaves of the later flowers small, shorter than the flowers; limb of the corolla 6-8 mm. wide.

3. *L. multiflorum*.

Floral leaves of the later flowers not reduced; limb of the corolla 8-20 mm. wide.

Hispid pubescent; corolla-tube bearded at the base within.

4. *L. Gmelini*.

Canescent; corolla-tube not bearded at the base within.

5. *L. canescens*.

Corolla-lobes fimbriate or dentate; later flowers cleistogamous.

Corolla 2.5-3 (rarely only 2) cm. long; lobes distinctly fimbriate.

6. *L. linearifolium*.

Corolla 2 cm. or less long; lobes dentate.

Corolla 15-20 mm. long; limb 8-20 mm. wide.

7. *L. mandanense*.

Corolla 10 mm. or less long; limb 6-8 mm. wide.

8. *L. breviflorum*.

1. *Lithospermum Torreyi* Nutt. On hills and in cañons from Mont. and Ida. to Colo. and Utah.—Alt. 8000-8600 ft.—Poverty Ridge, near Cimarron; below Parrott Post Office; Steamboat Springs.

2. *Lithospermum pilosum* Nutt. On hills from Alb. and B. C. to Colo. and Nev.—Leroux Creek, Delta Co.; Minturn; Denver.

3. *Lithospermum multiflorum* Torr. On hills and mountain sides and in cañons from Wyo. to N. M. and Ariz.; also in Mex.—Alt. 7000-10,000 ft.—Thompson's Park, La Plata Mountains; Crystal Park; Colorado Springs; Estes Park, Larimer Co.; Grayback mining camps and Placer Gulch; mouth of Cheyenne Cañon; North Cheyenne Cañon; Artist's Glen; Como, South Park; Cañon City; southeast of Ouray; Piedra; above Mancos; Pike's Peak; headwaters of Clear Creek; Horsetooth Gulch; Table Rock; Northwest of Soldier Cañon; Hotchkiss; Rist Cañon; Seven Lakes; Empire.

4. *Lithospermum Gmelini* (Michx.) Hitchc. (*L. hirtum* Lehm.) In sandy places and dry plains from N. Y. and Mont. to Fla. and N. M.—Denver (*Eastwood*).

5. *Lithospermum canescens* (Michx.) Lehm. On plains and in open woods from Ont. and N. D. to Ala., Tex. and Colo.—Alt. 4000-6000 ft.—Boulder.

6. *Lithospermum linearifolium* Goldie. (*L. angustifolium* Michx.) On prairies and plains from Ill., Man. and B. C. to Tex. and Ariz.—Alt. 4000-7000 ft.—Mt. Harvard; Colorado Springs; river-bluffs, north of La Veta; mesas near Pueblo; Cucharas River below La Veta; Trinidad; plains near Denver; Ft. Collins; Lamar; Durango; Spring Cañon; Boulder.

7. *Lithospermum mandanense* Spreng. On dry plains from N. D. and Alb. to Tex. and Ariz.—Alt. 4000-5000 ft.—Larimer Co.; Colorado City.

8. *Lithospermum breviflorum* Engelm. & A. Gray. (*L. albescens* Greene) On dry plains from Ark. and Colo. to Tex. and N. M.; also Mex.—Alt. 4000-6000 ft.—Arboles; Boulder.

II. *ONOSMODIUM* Michx. FALSE GROMWELL

1. *Onosmodium occidentale* Mackenzie. On plains and in sandy soil from Man. and B. C. to Mo., Tex. and Utah.—Alt. 3500-5000 ft.—Along Platte River, Denver; Ft. Collins; Boulder; Golden; Longmont.

Family 117. **VERBENACEAE** St. Hil. **VERVAIN FAMILY.**

Flowers in terminal spikes; corolla-limb 5-lobed; nutlets 4. 1. **VERBENA.**

Flowers in axillary peduncled short spikes; corolla-limb 4-lobed; nutlets 2. 2. **PHYLA.**

1. **VERBENA** L. **VERVAIN.**

Anthers not appendaged; flowers in elongated spikes, less than 8 mm long.

Plant tall, erect, strict; leaves not pinnatifid, only sometimes lobed at the base in the first species.

Bracts shorter than the calyx.

Bracts one-third longer than the calyx; pubescence dense, soft.

1. *V. hastata.*

2. *V. MacDougalii.*

Plant low, diffuse; leaves more or less pinnatifid; bracts much longer than the calyx.

3. *V. bracteosa.*

Anthers of the longer stamens appendaged by a gland on the connective; corolla 8 mm. long or more.

3. *V. ciliata.*

Calyx-lobes subulate.

5. *V. ambrosifolia.*

Calyx-lobes setaceous.

1. *Verbena hastata* L. In river valleys and moist meadows from N. S. and B. C. to Fla. and Calif.—Alt. 4000-7000 ft.—Timnath, Larimer Co.; foot-hills near Golden; Ft. Collins; Mason's river-front farm, Larimer Co.; Boulder.

2. *Verbena MacDougalii* Heller. In river valleys from Colo. to N. M. and Ariz.—Alt. about 7000 ft.—La Veta; Cucharas Valley, near La Veta; Arboles; Palmer Lake.

3. *Verbena bracteosa* Michx. (*V. rudis* Greene) On prairies and plains and in waste places from Ill., Alb. and B. C. to Fla. and Calif.—Alt. 4000-7500 ft.—Colorado Springs; Manitou; Arboles; Walsenburg; Platte River; Ft. Collins; Deer River; Cimarron; Rist Cañon; Dixon Cañon; Boulder.

4. *Verbena ciliata* Benth. On plains from Colo. to Tex. and Ariz.; also Mex.—Alt. 4000-5500 ft.—Mesas near Pueblo; Durango; Trinidad.

5. *Verbena ambrosifolia* Rydb. On plains from S. D. and Colo. to Tex. and Ariz.; also Mex.—Alt. 4000-6000 ft.—Boulder; Walsenburg; Rocky Ford, Otero Co.; foot-hills, Larimer Co.; Boulder Co.; La Porte; Soldier Cañon; Florence; Quimby.

2. **PHYLA** Lour.

1. *Phyla cuneifolia* (Torr.) Greene. (*Lippia cuneifolia* Torr.) On plains from S. D. and Wyo., to Tex and Ariz.—Alt. 4000-6000 ft.—Greeley, Weld Co.; Ft. Collins; foot-hills, Larimer Co.; Boulder Cañon; banks of Arkansas at Pueblo; Rocky Ford; Boulder.

Family 118. **LAMIACEAE** Lindl. **MINT FAMILY.**

Ovary of 4 united carpels; style not basal; nutlets laterally attached.

Flowers in small congested cymes, axillary to small bracts, and forming a raceme-like panicle; calyx-lobes shorter than the tube; leaves toothed.

1. **TEUCHRIUM.**

Flowers solitary in the axils of bracts similar to the leaves; calyx-lobes longer than the tube; leaves laciniate.

2. **MELOSMON.**

Ovary of 4 distinct or nearly distinct carpels; styles basal; nutlets basally attached. Corolla bilabiate.

- Calyx 2-lipped; both lips entire; stamens 4. 3. SCUTELLARIA.
 Calyx either 2-lipped and at least one of the lips toothed, or regularly 4-5
 toothed. 4. MARRUBIUM.
 Stamens included in the corolla-tube.
 Stamens exerted.
 Upper lip of the corolla concave.
 Anther-bearing stamens 4.
 Upper stamens longer than the lower.
 Calyx 5-toothed.
 Anther-sacs parallel or nearly so; stamens divergent.
 Anther-cells divaricate; anther approximate in pairs. 5. AGASTACHE.
 Calyx regularly 5-toothed; plants erect. 6. NEPETA.
 Calyx irregularly 5-toothed; plant trailing.
 Calyx distinctly 2-lipped. 7. GLECOMA.
 Upper stamens shorter than the lower. 8. DRACOCEPHALUM.
 Calyx distinctly 2-lipped, closed in fruit. 9. PRUNELLA.
 Calyx 5-toothed, not 2-lipped, open in fruit.
 Calyx membranous, inflated in fruit, faintly nerved.
 Calyx not membranous, not inflated in fruit, strongly 5-10-
 nerved. 10. PHYSOSTEGIA.
 Nutlets 3-sided, truncate above. 11. LEONURUS.
 Nutlets ovoid, nearly terete, rounded above. 12. STACHYS.
 Anther-bearing stamens 2.
 Connective of the anthers very long, articulated to the filaments,
 bearing a perfect anther at the ascending end and a reduced one
 or none at the other; calyx 2-lipped. 13. SALVIA.
 Connective of the anther short; anther-cells confluent; calyx equally
 5-toothed. 14. MONARDA.
 Upper lip of the corolla flat.
 Stamens curved, often converging.
 Calyx regularly 5-toothed; anther-bearing stamens 2.
 Calyx 2-lipped or irregularly 5-toothed. 15. POLIOMINTHA.
 Anther-bearing stamens 2. 16. HEDEOMA.
 Anther-bearing stamens 4. 17. CLINOPODIUM.
 Stamens straight, distant and diverging; calyx almost regularly 5-
 toothed; anther-bearing stamens 4. 18. MADRONELLA.
 Corolla nearly regular, 4-5-toothed.
 Anther-bearing stamens 2. 19. LYCOPUS.
 Anther-bearing stamens 4. 20. MENTHA.

1. *TEUCRIUM* L. GERMANDER.

1. *Teucrium occidentale* A. Gray. In thickets and among bushes in rich soil from Ont. and B. C. to Pa., Colo. and Calif.—Alt. 4000-6000 ft.—New Windsor, Weld Co.; Cañon City; Ft. Collins; Rocky Ford; Boulder.

2. *MELOSMON* Raf.

1. *Melosmon laciniatum* (Torr.) Small. (*Teucrium laciniatum* Torr.) On plains from Kans. and Colo. to Tex. and Ariz.—St. Charles River, Pueblo Co.; Walsenburg; Apishapa Creek, Otero Co.; Cañon City; Trinidad; Cedar Hills.

3. **SCUTELLARIA** L. SCULLCAP.

Perennials with horizontal rootstock.

Leaf-blades lanceolate or ovate, more or less distinctly toothed, at least the lower ones.

1. *S. galericulata*.

Leaf-blades entire or nearly so, oval, oblong or linear.

2. *S. Brittoni*.

Perennials with a woody caudex.

3. *S. resinosa*.

1. *Scutellaria galericulata* L. Along streams and in swamps from Newf. and Alaska to N. C. and Ariz.—Alt. 4000–8000 ft.—Gunnison; near Ouray; along Poudre; Ft. Collins; Mason's river-front farm; Alamosa; Andrew's Shetland ranch; Gunnison; Boulder; Estes Park, Larimer Co.; Ft. Collins.

2. *Scutellaria Brittoni* Porter. On hillsides and river valleys from Wyo. to Colo.—Alt. 5000–10,000 ft.—Eldora to Baltimore; Boulder; Fossil Beds; foot-hills near Boulder; Pike's Peak; near Denver; Green Mountain Falls; near Pike's Peak; Cucharas River below La Veta; New Windsor, Weld Co.; Ft. Collins; Ute Pass; Howe's Gulch; Dillon Cañon, Trinidad; Manitou; Dixon Cañon; Horsetooth Gulch; Spring Cañon; Soldier Cañon; Cache la Poudre; Table Rock.

Scutellaria Brittoni virgulata (A. Nels.) Rydb. (*S. virgulata* A. Nels.) A luxuriant variety with larger and thinner leaves.—Veta Pass; West Spanish Peak; Dillon Cañon.

3. *Scutellaria resinosa* Torr. On plains and hills from Kans. and Colo. to Tex. and Ariz.—"Plains of Colorado."

4. **MARRUBIUM** L. WHITE HOARHOUND.

1. *Marrubium vulgare* L. In waste places from Me. and B. C. to N. C. and Calif.; naturalized from Europe.—Ft. Collins.

5. **AGASTACHE** Clayt. GIANT-HYSSOP.

Calyx-lobes ovate-lanceolate, acute.

Leaves glaucous beneath; calyx tinged with blue; stem glabrous.

1. *A. anethiodora*.

Leaves not glaucous beneath; calyx green, yellowish or rarely pinkish; stem puberulent.

2. *A. pallidiflora*.

Calyx-lobes elongated lanceolate, acuminate, rose-tinged.

3. *A. urticifolia*.

1. *Agastache anethiodora* (Nutt.) Britton. (*Lophanthus anisatus* Benth.) Among bushes from Ont., Mackenzie River, and Alb. to Neb. and Colo.—Alt. 3700–7000 ft.—Rist Cañon, Larimer Co.; Dome Rock in Platte Cañon; mountains, Larimer Co.; Bosworth's Ranch, Stove Prairie.

2. *Agastache pallidiflora* (Heller) Rydb. (*Brittonastrum pallidiflorum* Heller; *B. Greenei* Briquet; *A. montana* Greene) In the mountains from Colo. to N. M. and Ariz.—Alt. up to 9000 ft.—Near Pagosa Peak.

3. *Agastache urticifolia* (Benth.) Kuntze. (*Lophanthus urticifolius* Benth.) On hillsides and valleys from Mont. and Wash. to Colo. and Calif.—Alt. 7000–8500 ft.—Four-mile Hill, Routt Co.; Glenwood Springs, Garfield Co.; Sierra Madre Range; Hamor's Lake, above Durango; Cerro Summit; Honnold; divide road to Steamboat Springs; Red Mountain road south of Ouray; Ouray; Steamboat Springs; summit of North Park Range, Routt Co.

6. *NEPETA* L. CATNIP, CATMINT.

1. *Nepeta Cataria* L. In waste places and around dwellings from N. B. and Ore. to Va. and Utah; naturalized from Europe.—Alt. 5000-8000 ft.—Along Uncompahgre River near Ouray; Ft. Collins; Boulder.

7. *GLECOMA* L. GROUND IVY.

1. *Glechoma hederacea* L. In waste places from Newf. and Minn. to Ga. and Colo.; introduced from Europe.—Boulder.

8. *DRACOCEPHALUM* L. DRAGON'S-HEAD.

1. *Dracocephalum parviflorum* Nutt. On hillsides and in valleys from N. Y. and Alaska to N. M. and Ariz.—Alt. 5000-10,000 ft.—Dry rocks, Cheyenne Mountain; mountain sides near Empire; Twin Lakes; Idaho Springs; foothills, Larimer Co.; Front Range, Larimer Co.; Mancos; Breckenridge; La Veta; Gunnison; Arboles; Sangre de Cristo Creek; Mt. Harvard; Palmer Lake; Grand Junction; Beaver Creek; Stove Prairie Hill; Empire; Boulder.

9. *PRUNELLA* L. SELF-HEAL, HBAL-ALL.

1. *Prunella vulgaris* L. In woods, among bushes and in wet places; naturalized from Europe.—Alt. 4000-9000 ft.—Arboles; Colorado Springs; Sangre de Cristo Creek; Ft. Collins; Mancos; Palmer Lake; Sargent; Steamboat Springs; Boulder.

10. *PHYSOSTEGIA* Benth. LION'S-HEART, FALSE DRAGON'S-HEAD.

1. *Physostegia parviflora* Nutt. Among bushes from Minn. and B. C. to Colo. and Ore.—Exact locality not given.

11. *LEONURUS* L. MOTHERWORT.

1. *Leonurus Cardiaca* L. In waste places from N. S. and Mont. to N. C. and Colo.—Alt. 4000-8000 ft.—Cucharas Creek near La Veta; Lower Boulder Cañon, Boulder Co.

12. *STACHYS* L. HEDGE NETTLE.

Leaf-blades oblong-ovate or cordate; corolla 12-15 mm. long; calyx-lobes almost equalling the calyx-tube.

1. *S. teucrifolia*.

Leaf-blades oblong-lanceolate; corolla 10-12 mm. long; calyx-lobes decidedly shorter than the calyx-tube.

2. *S. scopulorum*.

1. *Stachys teucrifolia* Rydb. In wet meadows in Colo. and Wyo.—New Windsor, Weld Co.; Colorado Springs; McCoy; Arboles.

2. *Stachys scopulorum* Greene. In wet meadows from Minn., Mackenzie River, and Alb. to N. M.—Alt. 4000-8500 ft.—Cucharas Valley, near La Veta; Grizzly Creek; Colorado Springs; South Park; Trimble Springs above Durango; Steamboat Springs, Routt Co.; Gunnison; Marshall Pass; Parlin, Gunnison Co.; along Conejos River north of Antonito; Dillon Cañon; Campton's ranch; Longmont; Ft. Collins; Table Rock.

13. *SALVIA* L. SAGE.

Corolla 15-30 mm. long; tube exserted.

1. *S. Pitcheri*.

Corolla 8-12 mm. long; tube included in the calyx.

2. *S. lanceolata*.

1. *Salvia Pitcheri* Torr. (*S. asurea grandiflora* Benth.) On prairies from Mo. and Neb. to Tex. and Colo.—"Eastern Colorado."

2. *Salvia lanceolata* Willd. On prairies, plains and hillsides from S. D. and Mont. to Tex. and Ariz.; also in Mex.—Alt. 4000-8500 ft.—Colorado Springs; hills about Box Cañon west of Ouray; Cucharas Valley, near La Veta; foot-hills west of Ft. Collins; Ft. Collins; Boulder.

14. *MONARDA* L. HORSE-MINT, WILD BERGAMOT.

Heads solitary at the ends of the stem and branches; stamens conspicuously exceeding the acute upper lip of the corolla.

Petioles and stem more or less hirsute-villous or lanate, the latter especially so under the nodes.

Leaves hirsute; stem and petioles hirsute-ciliate.

1. *M. comata*.

Leaves softly pubescent, especially below; stem, petioles and veins of the leaves lanate.

6. *M. Ramaleyi*.

Whole plant finely strigose or puberulent.

Petioles seldom over 5 mm. long.

Leaf-blades ovate-cordate; plant pale, more or less cinereous.

2. *M. menthaefolia*.

Leaves lanceolate with rounded or truncate base; plant green.

3. *M. stricta*.

Petioles 1-3 cm. long.

4. *M. mollis*.

Verrillate glomerules several in the upper axils of the leaves; stamens scarcely exceeding the emarginate or cleft upper lip.

5. *M. pectinata*.

1. *Monarda comata* Rydb. On hillsides in Colo.—Alt. 5000-8000 ft.—Pike's Peak; Wahatoya Creek; Ft. Collins; La Veta.

2. *Monarda menthaefolia* Benth. On hillsides and in valleys, especially among bushes from Ill., Man. and Ida. to Tex. and Colo.—Alt. 4000-9000 ft.—West Mancos Cañon; Pike's Peak; Hughes' Lake, Ouray; Cañon City; Redstone; Rist Cañon; Boulder; mountains between Sunshine and Ward.

3. *Monarda stricta* Wooten. On hillsides from Wyo. to N. M. and Ariz.—Alt. 5000-7000 ft.—Boulder; Durango; Piedra; Rist Cañon; Redstone.

4. *Monarda mollis* L. On prairies and among bushes from S. D. and Mont. to Ga. and Tex.—Alt. 4000-8500 ft.—Boulder; Four-mile Hill, Routt Co.

5. *Monarda pectinata* Nutt. (*M. citriodora* Coulter; *M. Nuttallii* A. Nels.) On plains, especially in sandy soil from Colo. and Utah to Tex. and Ariz.—Alt. 4000-6000 ft.—Durango; New Windsor, Weld Co.; Denver; foot-hills, Larimer Co.; Soldier Cañon; Spring Cañon; Platte Cañon; Tobe Miller's ranch; vicinity of Horsetooth Mountain; Poudre Cañon, near Narrows; along Poudre River; Boulder.

6. *Monarda Ramaleyi* A. Nels. In sandy soil in Colo.—Boulder Creek, near Boulder.

15. *POLIOMINTHA* A. Gray.

1. *Poliomintha incana* A. Gray. Dry places from western Tex. to southern Utah and Ariz.—San Juan Valley (*Brandegei*).

16. **HEDEOMA** Pers. PENNYROYAL.

Calyx-teeth about equal in length; floral leaves spreading or reflexed, hispid-ciliate.

1. *H. hispida*.

Calyx-teeth of the lower lip much longer than those of the upper; floral leaves mostly erect, cinereous-hispidulous.

Floral leaves longer than the subtended calyces; plant 1.5-4 dm. high.

2. *H. sancta*.

Floral leaves scarcely exceeding the subtended calyces; plant 1-1.5 dm. high.

3. *H. nana*.

1. *Hedeoma hispida* Pursh. In sandy soil from Ills. and Ass. to Ky and Colo.—Golden.

2. *Hedeoma sancta* Small. (*H. Drummondii* A. Gray, in part; not Benth.) On dry plains from Colo. to Tex. and N. Mex.—Alt. 4000-8000 ft.—Durango; Manitou; Glen Eyrie; Dolores.

3. *Hedeoma nana* (Torr.) Greene. (*H. dentata nana* Torr.; *H. Drummondii* A. Gray, in part) On dry plains and hills from Colo. and Utah to Tex. and Ariz.—Alt. 5000-7000 ft.—Manitou; Fossil Creek; between Hotchkiss and Smith's Fork; Durango.

17. **CLINPODIUM** L. BASIL-WEED.

1. *Clinopodium vulgare* L. In thickets from N. S. and Colo. to N. C. and N. M.—Alt. up to 10,000 ft.—Sierra Madre; Steamboat Springs.

18. **MADRONELLA** Greene.

Bracts thin and pale, oval to orbicular.

1. *M. parvifolia*.

Bracts thick, resembling the leaves, lanceolate or ovate-lanceolate, obtuse.

2. *M. dentata*.

1. *Madronella parvifolia* (Greene) Rydb. (*Monardella parvifolia* Greene) In cañons of Colo.—Alt. about 7000 ft.—Black Cañon.

2. *Madronella dentata* Rydb. (*Monardella dentata* Rydb.) On mountains of Colo.—Gray's Peak.

19. **LYCOPUS** L. WATER HOAR-HOUND.

Stem and lower surface of the leaves densely and finely pubescent, the former often velvety.

1. *L. velutinus*.

Stem sparingly and coarsely pubescent or glabrous; leaves glabrous or nearly so.

Leaves merely coarsely serrate.

2. *L. lucidus*.

Leaves sinuately pinnatifid.

3. *L. americanus*.

1. *Lycopus velutinus* Rydb. In wet places among bushes from Ark. and Colo. to Tex.—Base of the Rocky Mountains.

2. *Lycopus lucidus* Turcz. In wet soil, especially in woods and thickets from Neb. and B. C. to Colo. and Calif.—Alt. 4000-5000 ft.—Ft. Collins; Mason's river-front farm; Poudre flats.

3. *Lycopus americanus* Muhl. (*L. sinuatus* Ell.) In swamps and wet meadows from Newf. and B. C. to Fla. and Calif.—Alt. 4000-7000 ft.—Timnath, Larimer Co.; Cheyenne Mountain; New Windsor, Weld Co.; Table Rocks; Redstone; Ft. Collins; Poudre flats; Boulder.

20. MENTHA L. MINT.

Whorls of flowers forming terminal spikes.

1. *M. spicata*.

Whorls of flowers axillary.

Leaf-blades thin, dark green, not strongly veined, tapering gradually into slender petioles, which equal or exceed the flower-clusters.

2. *M. borealis*.

Leaf-blades thick, strongly veined, abruptly contracted into short petioles, which are much shorter than the flower-clusters.

3. *M. Penardi*.

1. *Mentha spicata* L. (*M. viridis* L.) Moist fields and waste places, from Me. and Minn. to Fla. and Colo. Introduced from Europe.—North Denver (*Eastwood*).

2. *Mentha borealis* Michx. (*M. canadensis glabrata* Benth; not *M. glabrata* Vahl.) In wet places from N. B. and Mont. to Va. and Utah.—Alt. 6500-7500 ft.—Cimarron and Squaw Hill.

3. *Mentha Penardi* (Briq.) Rydb. (*M. arvensis Penardi* Briq.) In wet places, especially among bushes, from Neb., Mackenzie River and B. C. to Colo. and Utah.—Alt. 4000-8000 ft.—Cañon City; along Uncompahgre River, near Ouray; Durango; Montrose; Gunnison; Pagosa Springs; Cucharas Valley, near La Veta; Ft. Collins; Kremmling; Parlin, Gunnison Co.; Alamosa; Walsenburg; Boulder.

Family 119. SOLANACEAE Pers. NIGHT-SHADE FAMILY.

Fruit a berry.

Corolla plicate; lobes usually induplicate; all our species herbs.

Calyx inflated and bladder-like in fruit.

Corolla open-campanulate, yellow or whitish, often with a dark center; seeds finely pitted; flowers nodding in anthesis.

1. *PHYSALIS*.

Corolla rotate, violet or purple; seeds rugose-tuberculate; flowers erect in anthesis.

2. *QUINCULA*.

Calyx not inflated and bladder-like in fruit.

Calyx closely investing the berry.

Stamens alike, not declined; low unarmed perennials.

3. *CHAMAESARACHA*.

Stamens dissimilar, declined; prickly annuals.

4. *ANDROCERA*.

Calyx not inclosing the berry.

5. *SOLANUM*.

Corolla little if at all plicate; its lobes valvate; shrubs.

6. *LYCIUM*.

Fruit a capsule.

Capsule circumscissile near the top, which separates as a lid; corolla irregular.

7. *HYOSCYAMUS*.

Capsule opening by valves; corolla regular.

Capsule prickly; seeds flat.

8. *DATURA*.

Capsule not prickly; seeds scarcely flattened.

9. *NICOTIANA*.

1. *PHYSALIS* L. GROUND-CHERRY, STRAWBERRY TOMATO.

Annuals with branching roots; fruiting calyx cordate-ovoid, acuminate, strongly 5-angled.

Leaf-blades very oblique, cordate, sinuate-dentate.

1. *P. pruinosa*.

Leaf-blades orbicular or broadly ovate, sinuately crenate, scarcely cordate and scarcely oblique at the base.

2. *P. neo-mexicana*.

Perennials with horizontal rootstock or rarely with woody caudices.

Pubescence if any not stellate, although in *P. pumila* with some branched hairs. Leaves and stem glabrous or the veins of the former and the upper part of the latter with scattered appressed hairs.

Leaf-blades ovate, ovate-lanceolate or oval.

3. *P. subglabrata*.

Leaf-blades lanceolate, oblanceolate or linear.

4. *P. longifolia*.

Leaves and stem more or less pubescent with spreading hairs.

Pubescence sparse, consisting of flat, sometimes jointed hairs, scarcely viscid.

Fruiting calyx ovoid, scarcely angled and scarcely sunken at the base; leaves thick, oblanceolate or spatulate to rhombic, subentire.

Leaves oblanceolate or spatulate; hairs all simple.

Pubescence very short; leaves narrowly oblanceolate.

Pubescence long; leaves spatulate.

Leaves broader, often rhombic; hairs on the lower surface branched.

Fruiting calyx pyramidal-ovoid, obtusely 5-angled and deeply sunken at the base; leaves ovate to lanceolate, generally more or less toothed.

Pubescence dense, viscid, partly of fine and short, partly of long flat jointed hairs.

Leaves large; blades over 5 cm. long, more or less cordate; long flat hairs numerous.

Leaves smaller; blades less than 5 cm. long; long flat hairs few, mostly confined to the calyx.

Plant erect or ascending.

Leaf-blades reniform or rounded cordate, coarsely sinuately toothed.

Leaf-blades rounded ovate or rhombic.

Plant prostrate, diffuse; leaf-blades nearly orbicular.

Pubescence fine, grayish, at least in part stellate.

1. *Physalis pruinosa* L. In cultivated soil, from Mass. and Iowa to Fla. and Mo.; introduced in Colo.—Ft. Collins.

2. *Physalis neo-mexicana* Rydb. (*P. pubescens* Coult.; not L.) In loose soil from Colo. to N. M. and Ariz.—Alt. about 6000 ft.—Colorado Springs.

3. *Physalis subglabrata* Mack. & Bush. In river valleys and cultivated grounds from Ohio and Mont. to Pa. and Colo.—Alt. up to 7000 ft.—Dome Rock in Platte Cañon.

4. *Physalis longifolia* Nutt. (*P. lanceolata laevigata* A. Gray) In river valleys and rich soil from Iowa and Mont. to Ark. and Ariz.; also in Mex.—Alt. 4000–8000 ft.—Gunnison; Berkeley Lake, Denver; Pueblo; Ft. Collins; Boulder.

5. *Physalis polyphylla* Greene. On plains of Colorado.—Walsenburg; Piedra.

6. *Physalis lanceolata* Michx. On plains and prairies from Ills. and S. D. to S. C. and Ariz.; also in Mex.—Alt. 4000–6000 ft.—Ft. Collins; Colorado Springs; Boulder.

7. *Physalis pumila* Nutt. (*P. lanceolata hirta* A. Gray) Prairies and river valleys from Mo. and Colo. to Tex.—Alt. 4000–7000 ft.—La Veta; Sulphur Spring, Soldier Cañon.

8. *Physalis virginiana* Mill. (*P. lanceolata* A. Gray, in part; not Michx.) On prairies, in river valleys and cultivated ground from N. Y., Mich. and Mont. to Fla. and Tex.—Alt. 4000–8000 ft.—Boulder Cañon; between Sunshine and Ward.

9. *Physalis heterophylla* Nees. (*P. virginiana* A. Gray; not Mill.) In cultivated fields and sandy or loose soil from N. B. and Sask. to Fla., Tex. and Utah.—Alt. 4000–6000 ft.—Timnath, Larimer Co.; Red Rock Cañon; New Windsor, Weld Co.; foot-hills, Larimer Co.; gulch west of Pennock's; Dixon Cañon; Howe's Gulch; Ft. Collins; Boulder; Longmont.

10. *Physalis hederifolia* A. Gray. On plains and rocky hills from Colo. to Tex. and Calif.—Exact locality not given.

11. *Physalis comata* Rydb. On hillsides from Neb. and Colo. to Tex.—Alt. 4000–5500 ft.—New Windsor, Weld Co.

12. *Physalis rotundata* Rydb. On plains from N. D. and Colo. to Tex. and N. M.—Sandy valleys, Larimer Co.; along Poudre River.

13. *Physalis Fendleri* A. Gray. On rocky hills and plains from Colo. and Utah to N. M. and Ariz.—Alt. 6000–8000 ft.—Cañon City; near Badito, between La Veta and Gardner; Piedra; Durango; Mancos; Walsenburg; Dolores.

2. QUINCULA Raf. PURPLE GROUND-CHERRY.

1. *Quincula lobata* (Torr.) Raf. (*Physalis lobata* Torr.) On plains and river bluffs from Kans. and Colo. to Tex. and Ariz.; also in Mex.—Alt. 4000–6000 ft.—Rocky Ford; Cheyenne Cañon; Spring Cañon; Ft. Collins; Dixon Cañon; Boulder; Longmont.

3. CHAMAESARACHA A. Gray.

Pubescence dense, hirsute as well as puberulent.

1. *C. conioides*.

Pubescence sparse, puberulent or stellate, hirsute if at all only on the calyx.

2. *C. Coronopus*.

1. *Chamaesaracha conioides* (Moric.) Britton. (*C. sordida* A. Gray) In clayey soil from Kans. and Colo. to Tex. and Ariz.; also in Mex.—Alt. up to 5000 ft.—Lamar; Pubelo.

2. *Chamaesaracha Coronopus* (Dunal) A. Gray. On clayey soil from Kans. and Colo. to Tex. and Ariz.—Alt. 4000–6000 ft.—Cañon City; McElmo Cañon; mesas near Pueblo; Walsenburg; Trinidad.

4. ANDROCERA Nutt.

1. *Androcera rostrata* (Dunal) Rydb. (*Solanum rostratum* Dunal; *Androcera lobata* Nutt.) On plains and in river valleys from N. D. and Wyo. to Tex. and N. M.; also in Mex.; introduced eastward to N. H. and Fla.—Alt. 4000–6000 ft.—Colorado Springs; Golden; New Windsor, Weld Co.; Ft. Collins; Denver; foot-hills west of Ft. Collins; Boulder.

5. SOLANUM L. NIGHTSHADE, POTATO.

Annuals.

Leaves pinnatifid.

1. *S. triflorum*.

Leaves sinuately dentate or entire.

Plant strigose or glabrous; berry black.

Leaves glabrous or nearly so; calyx-lobes obtuse.

2. *S. nigrum*.

Leaves decidedly strigose beneath; calyx-lobes abruptly acutish.

Corolla-lobes 3–4 mm. long.

3. *S. interior*.

Corolla-lobes 6–8 mm. long.

4. *S. Douglasii*.

Plant more or less viscid-villous; fruit greenish or yellowish.

5. *S. villosum*.

Perennials.

Plant green, glabrous or pubescent, but not stellate, never prickly; perennial with tubers.

6. *S. Jamesii*.

Plant silvery-white with stellate hairs; stem often prickly.

7. *S. elaeagnifolium*.

1. *Solanum triflorum* Nutt. On prairies and waste places, and especially in "prairie-dog towns" from Ont. and Alb. to Kans. and Ariz.—Alt. 4000–10,000 ft.—Cucharas Valley, near La Veta; Colorado Springs; Durango; Ft. Collins; Walsenburg; Ouray; Mountain View; along Uncompahgre River, near Ouray; Rocky Ford; Boulder.

2. *Solanum nigrum* L. In waste places, from N. S. and Wash. to Fla. and Tex.; introduced from Europe.—College lawn, Ft. Collins.

3. *Solanum interior* Rydb. In river valleys among bushes from Neb. and Colo. to Tex. and Calif.—Alt. 4000–6000 ft.—Cañon City; Timnath, Larimer Co.; along the Platte River, Denver; Bent's Fort.

4. *Solanum Douglasii* Dunal. In valleys of Calif., Ariz. and northwestern Mex. A specimen collected by Fremont is labelled: "Probably from the sources of the Platte, near the mountains." This is probably an error and very likely the specimen came from California.

5. *Solanum villosum* (Mill.) Lam. (*S. nigrum villosum* Mill.) In sandy soil from Wyo. and B. C. to Colo. and L. Calif.—Alt. 5000–6000 ft.—Boulder.

6. *Solanum Jamesii* Torr. In the mountains from Colo. to Tex. and Ariz.—Alt. 4000–7000 ft.—La Veta; Trinidad; Ft. Collins.

7. *Solanum elaeagnifolium* Cav. On plains from Mo. and Colo. to Tex. and Calif.; also in Mex.—Pueblo; Brantly Cañon, Los Animas Co.

6. LYCIUM L. MATRIMONY VINE.

1. *Lycium pallidum* Miers. On arid hills from Colo. and Utah to N. M. and Ariz.; also in Mex.—McElmo Creek; San Juan Valley.

7. HYOSCYAMUS L. BLACK HENBANE, HOG'S-BEAN.

1. *Hyoscyamus niger* L. In waste places from N. S., Mich. and Mont. to N. Y. and Colo.; introduced and naturalized from Europe.—Alt. up to 8000 ft.—Along Uncompahgre River, near Ouray.

8. DATURA L. THORN-APPLE, JIMSON-WEED.

Corolla 1.5–2 dm. long; capsule more or less fleshy, bursting irregularly.

1. *D. meteloides*.

Corolla about 1 dm. long; capsule dry; 4-valved.

Capsule erect; plant glabrous.

Corolla white; lower prickles of the capsule shorter.

Corolla violet; prickles all alike.

Capsule nodding; plant more or less cinerous.

2. *D. Stramonium*.

3. *D. Tatula*.

4. *D. discolor*.

1. *Datura meteloides* DC. Along streams from Colo. to N. M. and Calif.; also in Mex.—Alt. 5000–6000 ft.—McElmo Cañon; Montezuma Co.; Hovenweep Cañon; Grand Cañon.

2. *Datura Stramonium* L. In waste places from N. S. and Minn. to Fla., Tex. and Colo.; naturalized from Asia.—Boulder Cañon; Denver; Cherry Creek; Golden.

3. *Datura Tatula* L. In waste places from Ont. and Minn. to Fla., Tex. and Colo.; naturalized from tropical America.—Ft. Collins.

4. *Datura discolor* Benth. In river valleys from Colo. to Ariz. and Calif.; also in Mex.—Colorado, according to Gray, no specimens seen.

9. *NICOTIANA* L. TOBACCO.

Leaves clasping at the base; flowers diurnal.

1. *N. trigonophylla*.

Leaves petioled, not clasping at the base; flowers nocturnal.

2. *N. attenuata*.

1. *Nicotiana trigonophylla* Dunal. In dry grounds from Colo. and Utah to Tex. and Calif.; also in Mex.—"Southern Colorado" (Parry).

2. *Nicotiana attenuata* Torr. In dry or sandy ground from Mont. and B. C. to N. M. and Calif.—Alt. 6000-7000 ft.—Gypsum, Eagle Co.; Black Cañon; Salida; Glenwood Springs, Garfield Co.; Montrose; McElmo Cañon; Hotchkiss; Rustic; mountains between Sunshine and Ward.

Family 120. *RHINANTHACEAE* St. Hil. FIGWORT FAMILY.

Anther-bearing stamens 5.

Corolla rotate.

1. *VERBASCUM*.

Corolla funnelform, 2-lipped. (Occasional forms of)

5. *PENTSTEMON*.

Anther-bearing stamens 4 or 2.

Corolla spurred or saccate at the base on the lower side.

2. *LINARIA*.

Corolla neither spurred nor saccate on the lower side.

Stamens 5, 4 anther-bearing, the fifth sterile and often rudimentary.

Sterile stamen rudimentary, represented by a scale or gland on the upper inside of the corolla-tube or throat; corolla short.

Corolla gibbous at the base on the upper side; ovules and seeds few or solitary; annuals.

3. *COLLINSIA*.

Corolla not gibbous at the base, but more or less ventricose especially on the lower side; ovules and seeds numerous; perennials.

4. *SCROPHULARIA*.

Sterile stamen elongated, filiform to spatulate; corolla-tube elongated, tubular or funnelform.

Inflorescence thyrsoid-paniculate; seeds not with an ariliform, cellular-reticulate outer coat; corolla not gibbous at the base above; calyx deeply cleft.

5. *PENTSTEMON*.

Inflorescence racemose or spiciform; seeds with an ariliform, cellular-reticulate outer coat, calyx obtusely 5-lobed.

6. *CHIONOPHILA*.

Stamens 4 or 2.

Upper lip or lobes of the corolla external in the bud.

Anther-bearing stamens 4.

Corolla more or less bilabiate; sepals united into an angled tube; plants leafy-stemmed.

7. *MIMULUS*.

Corolla nearly regular; flowers solitary on scape-like peduncles from the basal rosette of leaves; plant acaulescent.

8. *LIMOSELLA*.

Anther-bearing stamens 2; calyx of 5, almost distinct sepals; sterile filaments short or wanting.

9. *GRATIOLA*.

Lower lip or lobes of the corolla external in the bud.

Stamens 2.

Corolla almost regularly 4-lobed.

10. *VERONICA*.

Corolla none or 2-lipped, cleft to near the base; upper lip entire; lower irregularly cleft or toothed.

11. *BESSEYA*.

Stamens 4.

Corolla slightly 2-lipped; stamens not ascending under the upper lip.

12. *GERARDIA*.

Corolla distinctly 2-lipped; stamens ascending under the upper lip.

Anther-sacs dissimilar; the inner one pendulous by its apex; leaves mostly alternate.

Calyx gamosepalous, i. e., all the sepals united below into a tube.

Calyx deeply cleft in front and behind, less deeply so (sometimes not at all) on the sides; upper lip of the corolla much longer than the 3-lobed lower one.

13. *CASTILLEJA*.

- Calyx almost equally 4-cleft; upper lip of the corolla slightly if at all longer than the 1-3 saccate lower one which is minutely or obsoletely toothed. 14. ORTHOCARPUS.
 Calyx 2-phyllous, i. e., cleft to the base on the sides, or, by absence of the lower part, 1-phyllous. 15. ADENOSTEGIA.
 Anther-cells alike, parallel; leaves mostly opposite.
 Calyx split below, or below and above, not inflated; capsule ovoid or oblong, oblique.
 Galea prolonged into a filiform recurved beak; throat with a tooth on each side. 16. ELEPHANTELLA.
 Galea not prolonged into a beak or this not filiform, straight or incurved; throat without teeth. 17. PEDICULARIS.
 Calyx 4-toothed, inflated and veiny in fruit; capsule orbicular. 18. RHINANTHUS.

1. VERBASCUM L. MULLEN.

Plant densely woolly; flowers in dense spikes.

1. *V. Thapsus*.

Plant glabrous or sparingly glandular; flowers racemose.

2. *V. Blattaria*.

1. *Verbascum Thapsus* L. In waste places and cultivated ground from N. S. and B. C. to Fla. and Calif.; naturalized from Europe.—Alt. 5000-6000 ft.—Boulder; 12 miles above mouth of Leroux Creek.

2. *Verbascum Blattaria* L. In waste places from Que. and B. C. to Fla. and Calif.; naturalized from Europe.—Boulder.

2. LINARIA Mill. BUTTER-AND-EGGS, TOAD-FLAX.

Corolla blue or white, 12 mm. long or less.

1. *L. canadensis*.

Corolla yellow, 2-3 cm. long.

2. *L. Linaria*.

1. *Linaria canadensis* (L.) Dum. In dry soil from N. S. and Wash. to Fla. and Calif.—Alt. 4000-8000 ft.—Boulder; Table Rock; Loveland; Spring Cañon.

2. *Linaria Linaria* (L.) Karst. (*L. vulgaris* Mill.) In waste places and fields from Newf. and Man. to Va. and Colo.; naturalized from Europe.—Gunnison; North Platte.

3. COLLINSIA Nutt. BLUE-EYED-MARY.

1. *Collinsia parviflora* Dougl. On shaded hillsides from Ont. and B. C. to Ariz. and Calif.—Alt. 5000-9000 ft.—Foothills, Larimer Co.; Veta Mountain; west of Ft. Collins; near Golden; Chicken Creek, West La Plata Mountains; Ward; Cimarron; North Boulder Peak; Palmer Lake; Rist Cañon; vicinity of Horsetooth; Beaver Creek; Trail Creek; Horsetooth Gulch; hills west of Soldier Cañon; Boulder.

4. SCROPHULARIA L. FIG-WORT, HEAL-ALL.

1. *Scrophularia occidentalis* (Rydb.) Bickn. In woods and among bushes from N. D. and Wash. to Ind. Terr. and Calif.—Alt. 4000-10,000 ft.—Georgetown; South Cheyenne Cañon; Turkey Creek and tributaries; near Parrott, La Plata Mountains; Cache la Poudre; Baxter's ranch; Moon's ranch; Horsetooth Gulch; Pennock's mountain ranch; Rist Cañon; gulch west of Soldier Cañon; Trail Creek; Boulder.

5. PENTSTEMON Soland. BEARD-TONGUE.

Corolla blue, purple, white or yellowish, more or less funnelliform or salverform.

Anthers bearded. I. GLABRI.

Anther glabrous or merely hirtello-ciliate along the line of dehiscence.

Plant not suffruticose at the base.

Leaves not linear-filiform.

Corolla decidedly funnelliform, i. e., throat much wider than the tube.

Sterile stamen glabrous; plant tall, perfectly glabrous.

I. GLABRI.

Sterile stamen bearded.

Plant perfectly glabrous, or slightly puberulent above.

Corolla strongly ventricose-gibbous; tube proper very short.

Corolla over 3 cm. long; stem-leaves clasping; plant tall.

II. GRANDIFLORI.

Corolla about 2 cm. long; leaves linear or oblanceolate, not clasping; plant low.

III. HALLIANI.

Corolla not ventricose-gibbous; tube gradually dilated into a funnelliform throat.

IV. ACUMINATI.

Plant glandular at least on the inflorescence.

Stem glabrous below.

V. GLAUCI.

Stem glandular or puberulent.

VI. CRISTATI.

Corolla-tube almost cylindrical or slightly widening upwards; corolla less than 2 cm. long.

Stems several from a branching rootstock, low and weak.

VII. HARBOURIANI.

Stems solitary or a few from a taproot or short caudex.

VIII. CONFERTI.

Leaves linear-filiform.

Corolla-limb not strongly oblique; sterile stamen bearded.

IX. LARICIFOLII.

Corolla-limb strongly oblique; sterile stamen glabrous.

X. AMBIGUI.

Plant suffruticose at the base.

XI. CAESPITOSI.

Corolla red, almost tubular.

Anthers opening for nearly their whole length.

XII. BARBATI.

Anthers opening only on their proximal part.

XIII. BRIDGESIANI.

I. GLABRI.

Anthers bearded with long villous hairs.

Leaves and stem glabrous.

Calyx-lobes acute or obtuse.

1. *P. strictus*.

Calyx-lobes long-acuminate.

2. *P. strictiformis*.

Leaves and lower part of the stem densely and minutely puberulent.

3. *P. comarrhenus*.

Anthers glabrous or sparingly short-hirsute.

Anthers sparingly bearded.

Stem-leaves all narrowly lanceolate.

Calyx-lobes with narrow scarious margins, not auricled.

Corolla about 1.5 cm. long; plant puberulent.

4. *P. Fremontii*.

Corolla about 2 cm. long; plant glabrous.

5. *P. utahensis*.

Calyx-lobes with very broad scarious margins, forming erose auricles.

6. *P. oreophilus*.

Stem and leaves glabrous.

7. *P. alpinus*.

Stem and leaves more or less puberulent.

8. *P. Brandegei*.

Upper stem-leaves broadly ovate or cordate.

9. *P. unilateralis*.

Anthers and sterile filaments glabrous.

II. GRANDIFLORI.

One species.

10. *P. grandiflorus*.

III. HALLIANI.

One species.

11. *P. Hallii*.

IV. ACUMINATI.

Inflorescence interrupted; bracts except the lowermost shorter than the flowers; basal leaves spatulate or oblanceolate.

Bracts ovate to almost orbicular.

12. *P. cyathophorus*.

Bracts lanceolate to linear-lanceolate.

Calyx-lobes broadly obovate, scarious, erose, abruptly contracted into a very short acumination.

13. *P. Watsonii*.

Calyx-lobes ovate or lanceolate, acute or gradually acuminate.

Calyx-lobes lanceolate; plant 3-4 dm. high.

14. *P. secundiflorus*.

Calyx-lobes ovate; plant 2 dm. high or less.

15. *P. Fendleri*.

Inflorescence dense; bracts large, long-acuminate, most of them exceeding the flowers; basal leaves linear or nearly so, narrower than the stem-leaves.

16. *P. angustifolius*.

V. GLAUCI.

One species.

17. *P. glaucus*.

VI. CRISTATI.

Corolla-tube decidedly gibbous-ventricose; sterile stamen densely yellow-villous; corolla purplish.

Basal leaf-blades obovate or spatulate or ovate, broader than the cauline leaves; corolla about 1.5 cm. long.

18. *P. Moffattii*.

Basal leaf-blades linear to linear-ob lanceolate, usually narrower than the upper cauline leaves; corolla 2-3 cm. long.

19. *P. Jamesii*.

Corolla-tube funnelform, scarcely gibbous; sterile stamen sparingly yellow-villous; corolla white.

20. *P. albidus*.

VII. HARBOURIANI.

One species.

21. *P. Harbourii*.

VIII. CONFERTI.

Leaves more or less dentate.

Calyx-lobes elongated-lanceolate, not scarious; flowers ascending; stem-leaves linear-lanceolate or linear.

22. *P. gracilis*.

Calyx-lobes ovate-lanceolate, scarious-margined below and usually toothed; stem-leaves oblong-lanceolate or lanceolate.

23. *P. humilis*.

Leaves entire.

Calyx glabrous or puberulent, but not at all glandular; its lobes with very broad, erose, scarious margins and abrupt acumination.

Corolla over 1 cm. long; upper stem-leaves broadly lanceolate, often rounded at the base; plant 3 dm. high or more.

24. *P. Rydbergii*.

Corolla less than 1 cm. long; upper stem-leaves linear-lanceolate; plant seldom over 3 dm. high.

25. *P. procerus*.

Calyx and inflorescence more or less glandular.

Plant glabrous or nearly so.

22. *P. gracilis*.

Plant decidedly puberulent.

26. *P. radicosus*.

IX. LARICIFOLII.

One species.

27. *P. laricifolius*.

X. AMBIGUI.

One species.

28. *P. ambiguus*.

XI. CAESPITOSI.

Leaf-blades obovate, spatulate or broadly oblanceolate.

Leaves green and glabrous or slightly puberulent; calyx-lobes oblong-lanceolate.

29. *P. suffrutescens*.

Leaves densely grayish or whitish puberulent; calyx-lobes lanceolate.

30. *P. caespitosus*.

Leaf-blades narrowly oblanceolate to linear or filiform.

Calyx-lobes scarcely scarious-margined, entire; inflorescence few-flowered; floral leaves like the rest.

Leaves green and glabrate.

31. *P. xylus*.

Leaves densely canescent-puberulent.

32. *P. teucrioides*.

Calyx-lobes scarious-margined, dentate or erose; inflorescence many-flowered, racemiform; floral leaves reduced.

33. *P. linarioides*.

XII. BARBATI.

Lower lip bearded within.

Lower lip glabrous within.

Anthers glabrous; leaves usually glabrous.

Anthers long-bearded; leaves puberulent.

34. *P. barbatus*.

35. *P. Torreyi*.

36. *P. trichander*.

XIII. BRIDGESIANI.

One species.

37. *P. Bridgesii*.

1. *Pentstemon strictus* Benth. On hills from Wyo. to Colo. and Utah.—Alt. 6000–9000 ft.—Cimarron; Chicken Creek, West La Plata Mountains; Elk River, Routt Co.; Cerro Summit; La Plata River; Pearl; Hotchkiss; between Porter and Durango; North Park; Walton; Steamboat Springs; Walden.

2. *Pentstemon strictiformis* Rydb. On hills and plains of Colo.—Alt. 7500–9000 ft.—Mesa Verde; hills about Box Cañon, west of Ouray; Arboles; Grayback mining camps and Placer Gulch; Mancos; Sangre de Cristo Creek; Antonito; Redcliffe.

3. *Pentstemon comarrhenus* A. Gray. On dry hills in Colo. and Utah.—Alt. 5000–7000 ft.—Mancos; Cedar Edge; Piedra.

4. *Pentstemon Fremontii* T. & G. On dry hills from Wyo. to Colo. and Utah.—Meeker, Rio Blanco County.

5. *Pentstemon utahensis* (S. Wats.) A. Nels. (*P. glaber Utahensis* S. Wats.) In the mountains from Wyo. and Ida. to Colo. and Utah.—Alt. up to 10,000 ft.—Hahn's Peak; Marshall Pass; Hotchkiss; Horsetooth Gulch; Leroux Creek; Anita Peak.

6. *Pentstemon oreophilus* Rydb. In the mountains of Colo.—Alt. 8000–10,000 ft.—Mountain sides near Empire; Bald Mountain; Halfway House; Larimer Co.; Manitou; South Cheyenne Cañon; Eldora to Baltimore; Bosworth's ranch; Horsetooth Mountain; Stove Prairie.

7. *Pentstemon alpinus* Torr. (*P. glaber alpinus* A. Gray; *P. riparius* A. Nels.) In the mountains of Colo. and Wyo., especially along streams.—Alt. 6000–10,000 ft.—Flagstaff Hill; mountain sides near Empire; Bosworth's ranch; Stove Prairie; Horsetooth Mountain; Ward; Empire.

8. *Pentstemon Brandegei* Porter. In the mountains from Mont. to Colo.—Alt. 6000–9000 ft.—Dry rocks, Cheyenne Mountain; Colorado Springs; Pueblo; Pike's Peak.

9. *Pentstemon unilateralis* Rydb. (*P. secundiflorus* A. Gray; not Benth.) In the mountains from Wyo. to N. M.—Alt. 5500–10,000 ft.—Near Empire; Georgetown; Douglass Co.; Sangre de Cristo Creek; Gunnison; Central City; Manitou; Ft. Collins; Golden; Idaho Springs; Como, South Park; Mt. Harvard; Colorado Springs; Leroux Creek; gulch west of Pennock's; Hayden's ranch; Clear Creek; Spring Cañon; Poudre River; La Porte; Empire; Eldora to Baltimore; Boulder.

10. *Pentstemon grandiflorus* Nutt. On prairies and plains from Ills., Wisc. and Ore. to Ind. Terr. and Utah.—Gray's Peak.

11. *Pentstemon Hallii* A. Gray. On the higher mountains of Colo.—Alt. 10,000–14,000 ft.—Pike's Peak; Seven Lakes; Dead Lake; Mount Garfield; mountains above Como; Argentine Pass; Gray's Peak; above Boreas.

12. *Pentstemon cyathophorus* Rydb. In the mountains of Colo.—Alt. about 8500 ft.—Pearl; Grizzly Creek; North Park.

13. *Pentstemon Watsonii* A. Gray. In the mountains from Colo. to Nev. and Ariz.—Glenwood Springs.

14. *Pentstemon secundiflorus* Benth. (*P. acuminatus* A. Gray, mainly; not Dougl.) On dry plains and hills from Wyo. to N. Mex.—Alt. 5000-9000 ft.—Near Empire; Manitou; Colorado Springs; Ft. Collins; foothills, Larimer Co.; Denver; South Park; Crystal Park; North Park, near Teller; north of La Porte; Horsetooth Gulch; Wray; Platte Cañon; Dixon Cañon; Trail Creek; Camp Creek.

15. *Pentstemon Fendleri* A. Gray. On high plains of Colo. and to N. M. and Calif.—Arboles; Salida.

16. *Pentstemon angustifolius* Pursh. (*P. coeruleus* Nutt.) On plains from S. D. and Mont. to Colo.—Alt. 4000-6000 ft.—Ft. Collins; New Windsor; Redcliffe; Colorado Springs.

Pentstemon angustifolius caudatus (Heller) Rydb. (*P. caudatus* Heller) A taller variety with broader leaves from Colo. and N. Mex.—Livermore; Cucharas River, below La Veta; Ojo; butte, 5 miles southwest of La Veta; Walsenburg; river-bluffs north of La Veta; mesas near Pueblo; Colorado College.

17. *Pentstemon glaucus* Graham. In the mountains from Wyo. and Utah to Colo. and Ariz.—Alt. 8000-12,000 ft.—Headwaters of Clear Creek; Half-moon Creek; Dark Cañon, Pike's Peak; Chambers' Lake; mountains south of Ward, Boulder Co.; Berthoud Pass, near Georgetown; Pike's Peak; Silver Plume; Cameron Pass; near Graymont; near Pagosa Peak; Salida; Gore Pass; Anita Peak; Hahn's Peak; Red Mountain road, south of Ouray; near La Plata; Palsgrove Cañon; Marshall Pass; Argentine Pass; near Seven Lakes, Pike's Peak; Villa Grove; Silverton; Robinson; Alpine Tunnel; Gray's Peak; Little Kate Mine, La Plata Mountains; Steamboat Springs.

Pentstemon glaucus stenosepalus A. Gray. A variety with long-attenuate calyx-lobes.—Graymont; Ragged Mountain; Michigan Hill; Boreas; Beaver Creek; Gore Pass; Four-mile Hill, Routt Co.; Seven Lakes, Pike's Peak; Eldora to Baltimore; Chambers' Lake; Spicer.

18. *Pentstemon Moffattii* Eastw. On dry table-lands of western Colo.—Mancos.

19. *Pentstemon Jamesii* Torr. On plains and dry valleys in Colo. and S. D.—Alt. 5000-9000 ft.—Cucharas Valley, near La Veta; Swallows, between Pueblo and Cañon City; mesas near Pueblo; near Badito; Sangre de Cristo Creek; Walsenburg; Rocky Ford.

20. *Pentstemon albidus* Nutt. On prairies and plains from Ass. and Ida. to Kans. and Colo.—Near Denver; Eads; Sterling; Grand Junction.

21. *Pentstemon Harbourii* A. Gray. On the higher peaks of Colo.—Alt. 9000-13,000 ft.—Rock-slide at the foot of Mt. McClellan; Kelso Valley; Little Kate Basin, La Plata Mountains; West Spanish Peak; mountains above Ouray; Mt. Richtofen.

22. *Pentstemon gracilis* Nutt. On plains and prairies from Man. and Sask. to Tex. and Colo.—Alt. 4000-8000 ft.—Divide west of salt-works, South Park; north of Cheyenne Cañon; Wahatoya Creek; Brantly Cañon; Table Rock; Dillon Cañon, Trinidad; Palmer Lake.

23. *Pentstemon humilis* Nutt. On plains and hills from Mont. and Alb. to Colo. and Nev.—Alt. 5000-10,000 ft.—South Park; near Denver; headwaters

of Clear Creek; Crystal Park; Cheyenne Mountain; North Cheyenne Cañon; Turkey Creek and tributaries; Wahatoya Cañon; near Georgetown; foot-hills west of Ft. Collins; foot-hills below Colorado Springs; Dale Creek, Larimer Co.; Dixon Cañon; Rist Cañon; gulch west of Pennock's; gulch south of Boreas; Horsetooth Gulch; gulch south of Boulder; Platte Cañon; Empire; Eldora to Baltimore; Camp Creek.

24. *Pentstemon Rydbergii* A. Nels. (*P. erosus* Rydb.) In the mountains from Wyo. and Wash. to Colo.—Alt. 7000–10,000 ft.—Steamboat Springs; Rabbit-Ears, Larimer Co.; South Park; Sargent's; Gunnison; Marshall Pass; Chicken Creek, West La Plata Mountains; Pitkin; Columbine; Parlin, Gunnison Co.; Robinson; Sheephorn Divide, Middle Park; Rabbit-Ears Pass; Salida; Walton Creek; Como; Mt. Richtofen on the Michigan; Big South; Eldora to Baltimore.

25. *Pentstemon procerus* Dougl. On hills and mountains from Sask. and B. C. to Colo. and Calif.—Alt. 8000–11,000 ft.—Headwaters of Clear Creek; Bard Creek Valley, near Empire; Chambers' Lake; North Park; Mt. Harvard; Twin Lakes; Como; between Como and Boreas; Walden.

26. *Pentstemon radicosus* A. Nels. On plains from Ida. and Mont. to Colo.—Pinkham Creek.

27. *Pentstemon laricifolius* H. & A. On dry hills from Wyo. and Ore. to Colo.—Medicine Bow Mountains, Larimer Co.

28. *Pentstemon ambiguus* Torr. On plains from Colo. and Utah to Tex. and Ariz.; also in Mex.—Rocky Ford; Sterling.

29. *Pentstemon suffrutescens* Rydb. (*P. caespitosus suffruticosus* A. Gray; *P. procumbens* Greene) On dry hills and mountains of Colo. and Utah.—Alt. up to 10,000 ft.—Kebler Pass; Ridgway.

30. *Pentstemon caespitosus* Nutt. On dry hills from Wyo., Utah and Colo.—McCoy's, Eagle Co.; north of Craig.

31. *Pentstemon xylus* A. Nelson. In the mountains of Colo.—Alt. 6500–10,000 ft.—Cimarron; South Cottonwood Gulch, Chaffee Co.; Como; Mancos; Gunnison.

32. *Pentstemon teucrioides* Greene. On dry hills in Colo.—Alt. about 7250 ft.—Sapinero.

33. *Pentstemon linarioides* A. Gray. (*P. Coloradoensis* A. Nels.) On dry hills and plains from Colo. and Utah to N. M. and Ariz.; also in Mex.—Alt. 6500–7500 ft.—Dolores; Mancos Cañon; Durango.

34. *Pentstemon barbatus* Nutt. In the mountains from Colo. to Ariz.; also in Mex.—"Mountains of Colorado."

35. *Pentstemon Torreyi* Benth. (*P. barbatus Torreyi* A. Gray) On hill-sides in the mountains from Colo. to N. M. and Ariz.; also in Mex.—Alt. 7000–10,000 ft.—Lake City; Artist's Glen; Placer; mesas near Buena Vista; Sangre de Cristo Creek; Salida; North Cheyenne Cañon; Black Cañon; Dillon Cañon.

36. *Pentstemon trichander* (A. Gray) Rydb. (*P. barbatus trichander* A. Gray) In the mountains of Colo.—Alt. 7000–10,000 ft.—Mesa Verde; Piedra; Buena Vista; Durango.

37. *Pentstemon Bridgesii* A. Gray. Rocky banks from Colo. to Ariz. and Calif.—Alt. 6000–8000 ft.—El Late (*Brandegeae*).

6. *CHIONOPHILA* Benth.

1. *Chionophila Jamesii* Benth. In the higher mountains of Colo. and Southern Wyo.—Alt. 11,000–14,000 ft.—Mt. Hayden; near Pagosa Peak; Pike's Peak; Gray's Peak; mountains above Boreas; Massif de l'Arapahoe; Douglass Mountain, Georgetown; Beaver Creek; Mt. Bartlett; Mt. Robinson; Red Mountain; Ethel Peak.

7. *MIMULUS* L. MONKEY-FLOWER.

Calyx oblique, decidedly inflated in fruit; upper tooth much larger than the rest; corolla yellow.

Calyx-teeth acute; stem neither rooting at the nodes nor floating.

Perennials, usually tall and erect, 3–6 dm. high; corolla 2–3 cm. long; calyx-teeth not much unequal.

Leaves glabrous; stem pubescent only above.

Leaves and stem pubescent throughout.

Annuals, slender or low; corolla 2 cm. or less long; upper calyx-tooth much elongated.

Corolla 1.5–2 cm. long, at least twice as long as the calyx.

Corolla 5–8 mm. long, about half longer than the calyx.

Calyx-teeth obtuse; stem decumbent or floating, rooting at the nodes.

Calyx neither oblique nor inflated; its lobes nearly equal.

Perennials; flowers 1–4 cm. long; sepals linear-lanceolate.

Tall, with erect stem, 3–10 dm. high; corolla crimson or rose.

Low or slender, weak; corolla yellow.

Annuals; flowers 0.5–1 cm. long; sepals ovate, triangular or broadly lanceolate.

Leaves petioled; blades cordate to ovate-lanceolate.

Leaves sessile, oblong, lanceolate or linear.

1. *M. Langsdorffii*.

2. *M. puberulus*.

3. *M. nasutus*.

4. *M. Hallii*.

5. *M. Geyeri*.

6. *M. Lewisii*.

7. *M. moschatus*.

8. *M. floribundus*.

9. *M. gratioloides*.

1. *Mimulus Langsdorffii* Sims. (*M. luteus* A. Gray; not L.; *M. minor* A. Nels.) In swamps and along streams, especially in muddy places, from Ass. and Alaska to N. M. and Calif.; also in Mex.—Alt. 8000–12,000 ft.—Hahn's Peak; Chambers' Lake; Van Boxle's ranch, above Cimarron; Grayback mining camps and Placer Gulch; Manitou; headwaters of Sangre de Cristo Creek; Ouray; Twin Lakes; bank of Michigan; Cameron Pass; Twin Lakes; Four-mile Hill; Gypsum Creek Cañon; Berthoud Pass; Empire; between Sunshine and Ward; Gray's Peak; Veta Pass; Silver Plume.

2. *Mimulus puberulus* Greene. In wet places in the mountains of Colo.—Alt. 7500–10,000 ft.—Four miles west of Cameron Pass; Villa Grove, Steele Cañon; Breckenridge; Dix; Bob Creek, West La Plata Mountains; Red Mountain; Pagosa Springs; west of Ouray.

3. *Mimulus nasutus* Greene. In wet places in the mountains from Ida. and B. C. to Colo. and Calif.—Alt. 9000–10,000 ft.—Rico; Ouray; Horsetooth Gulch; Pennock's.

4. *Mimulus Hallii* Greene. In wet places in the mountains of Colo.—Alt. up to 8500 ft.—Georgetown; Piedra; Horsetooth Gulch; gulch west of Pennock's.

5. *Mimulus Geyeri* Torr. (*M. Jamesii* T. & G.) In water from Mich. and N. D. to Ills. and Colo.—Alt. 4000–7000 ft.—Boulder; Colorado Springs; Cucharas Valley, near La Veta; Montrose; Spring Cañon; New Windsor.

6. *Mimulus Lewisii* Pursh. Along streams from Minn., Mont. and B. C. to Colo., Ariz. and Calif.—North Park.

7. *Mimulus moschatus* Dougl. In wet places from Ont. and B. C. to Colo. and Calif.—Alt. up to 9000 ft.—Continental Divide, Routt Co.; Steamboat Springs.

8. *Mimulus floribundus* Dougl. In wet places, especially in sandy soil, from Mont. and B. C. to Ariz. and Calif.—Alt. 5000-8000 ft.—Boulder; Lower Boulder Cañon; Cimarron; Black Cañon; Golden; mountains, Larimer Co.; Ft. Collins; west of Soldier Cañon; Horsetooth Gulch; Cache la Poudre; mountains between Sunshine and Ward.

9. *Mimulus gratioides* Rydb. On hillsides in southern Colo.—Alt. 7000-8000 ft.—Butte, 5 miles southwest of La Veta; Crystal Creek.

8. LIMOSELLA L. MUDWORT.

1. *Limosella aquatica* L. In shallow water and mud from Lab. and B. C. to Colo. and Calif.; also in Europe and Asia.—Alt. 4000-8000 ft.—Ft. Collins; Denver; North Platte, below Hebron; Parlin; Estes Park.

9. GRATIOLA L. HEDGE HYSSOP.

1. *Gratiola virginiana* L. In wet places, especially around springs, from Que. and B. C. to Fla. and Calif.—Alt. 5000 ft.—Garland; Boulder; Ft. Collins; Alamosa.

10. VERONICA L. SPEEDWELL, BROOKLIME.

Flowers in axillary racemes.

Leaves all short-petioled; leaf-blades ovate, oblong or oval.

1. *V. americana*.

Leaves of the flowering shoots at least sessile, lanceolate to linear.

2. *V. Anagallis*.

Flowers in terminal spikes or racemes, or solitary in the axils of the leaves.

Perennials; flowers in terminal spikes or racemes; bracts reduced and unlike the leaves.

All leaves sessile, ovate or ovate-oblong; capsules obovate or oval, merely emarginate.

3. *V. Wormskjoldii*.

Lower leaves petioled; blades rounded-oval or the upper oblong; capsule obcordate.

4. *V. serpyllifolia*.

Annuals; flowers solitary in the axils of the leaves, i. e., bracts resembling the other leaves and only slightly reduced.

Peduncles shorter than the oblong to linear stem-leaves.

5. *V. salapensis*.

Peduncles longer than the ovate stem-leaves.

6. *V. Buxbaumii*.

1. *Veronica americana* Schwein. In water from Anticosti and Alaska to Pa., Colo. and Calif.—Alt. 4000-12,000 ft.—Headwaters of Sangre de Cristo Creek; headwaters of Pass Creek; Mancos; Ft. Collins; Green Mountain Falls; Van Boxle's ranch, above Cimarron; La Veta; Red Mountain; Horsetooth Gulch; Twin Lakes; Trail Creek; Poudre Cañon; Gore Pass; gulch west of Pennock's; Howe's Gulch; Boulder.

Veronica americana crassula Rydb. (*V. crenatifolia* Greene) A low variety with fleshy entire leaves. From S. D. and Mont. to Colo. and Utah.—Red Mountain.

2. *Veronica Anagallis* L. In water from N. S. and B. C. to N. C. and Ariz.—Alt. 5000-8000 ft.—Wahatoya Creek; Ft. Collins.

3. *Veronica Wormskjoldii* R. & S. (*V. alpina* A. Gray, in part; not L.) In wet places from Greenl. and Alaska to N. H., Colo. and Ariz.—Alt. 9000-

12,000 ft.—Summit of North Park Range, Routt Co.; four miles west of Cameron Pass; Silver Plume; Little Kate Basin, La Plata Mountains; Trappers' Lake; near Pagosa Peak; Seven Lakes; Marshall Pass; Tennessee Pass; Mirror Lake; Alpine Tunnel; Silverton; Beaver Creek; Leroux Creek; Berthoud Pass.

4. *Veronica serpyllifolia* L. In fields, thickets and open woods from Lab. and Alaska to Ga., Colo. and Calif.; also in Europe and Asia.—Alt. 8000–11,000 ft.—Caribou; Marshall Pass; Red Mountain, south of Ouray; Gray-back mining camps and Placer Gulch; headwaters of Sangre de Cristo Creek; Bob Creek, West La Plata Mountains; Silverton; Beaver Creek; Hotchkiss; Gore Pass.

5. *Veronica zalapensis* H. B. K. (*V. peregrina* A. Gray, in part; not L.) In sandy soil from Sask. and B. C. to Tex. and Calif.—Alt. 5000–8500 ft.—Ft. Collins; Table Rock; Manitou; foothills, Larimer Co.; Mancos; Pagosa Springs; Ft. Collins; Idaho Springs; Cerro Summit; Veta Pass; Boulder; Grizzly Creek.

6. *Veronica Buxbaumii* Tenare. In waste places from N. S. and N. Y. to Colo.; adventive from Europe and Asia.—Boulder.

11. BESSEYA Rydb.

Corolla present.

Flowers not reflexed; calyx-lobes 3–4.

Upper lip of the purple corolla twice as long as the calyx; plant 1–1.5 dm. high. 1. *S. alpina*.

Upper lip of the corolla only slightly longer than the calyx; plant 1.5–3 dm. high.

Corolla purple or pink, not ciliate; divisions of the lower lip obtuse. 2. *S. plantaginea*.

Corolla white or yellowish, ciliate on the margin; divisions of the upper lip acute. 3. *S. Ritteriana*.

Flowers reflexed; calyx-lobes 2; corolla greenish-white. 4. *S. reflexa*.

Corolla lacking. 5. *S. gymnocarpa*.

1. *Besseyia alpina* (A. Gray) Rydb. (*Synthyris alpina* A. Gray) On the higher mountains of Wyo. and Colo.—Alt. 10,000–14,000 ft.—Mt. Harvard; West Spanish Peak; Gray's Peak; Massif de l'Arapahoe; headwaters of Clear Creek; Ethel Peak.

2. *Besseyia plantaginea* (Benth.) Rydb. (*Synthyris plantaginea* Benth.) On hillsides and mountains from Wyo. to N. M. and Ariz.—Alt. 6000–13,500 ft.—Mountain near Veta Pass; Pike's Peak; mountains above Ouray; hills southeast of La Veta; mesas near Colorado Springs; South Cheyenne Cañon; butte, 5 miles southwest of La Veta; Wahatoya Cañon; Manitou; Gray's Peak; Minnehaha; Cascade; Artist's Glen; Mt. Garfield; headwaters of Clear Creek; Como; Bear Creek Cañon.

3. *Besseyia Ritteriana* (Eastw.) Rydb. (*Synthyris Ritteriana* Eastw.; *S. flavescens* A. Nelson) On the higher mountains of Colo.—Alt. 7000–12,000 ft.—Red Mountain; Bear Creek Divide, West La Plata Mountains; Cimarron; Cumberland Basin.

4. *Besseyia reflexa* (Eastw.) Rydb. (*Synthyris reflexa* Eastw.) On the mountains of Colo.—Kendall Basin, near Silverton.

5. *Besseyia gymnocarpa* (A. Nels.) Rydb. (*Wulfenia gymnocarpa* A. Nels.; *Synthyris rubra* A. Gray, in part; not Benth.) On hills from S. D. and Alb. to Colo. and Utah.—Wood's ranch.

12. GERARDIA L.

1. *Gerardia Besseyana* Britton. On prairies and river bottoms from Iowa and Wyo. to La. and Colo.—Alt. 4000-5000 ft.—Boulder; Platte River, Denver; Ft. Collins; Longmont; along the Poudre; Longmont; Cherry Creek.

13. CASTILLEJA Mutis. PAINTED CUP, PAINTER'S BRUSH.

Annuals or biennials.
Perennials.

I. STENANTHAE.

Galea several times longer than the very short lip, usually at least $\frac{3}{4}$ as long as the corolla-tube; bracts in most species tinged with scarlet, crimson or rose.

Calyx cleft much deeper in front than behind.

II. LINARIÆFOLIAE.

Calyx about equally cleft in front and behind.

Stem villous-canescens; bracts entire, or trilobed with broad, rounded middle lobe.

III. INTEGRÆ.

Stem glabrous or pubescent, but not canescent.

Leaves entire or the uppermost rarely slightly 3-lobed; corolla-lip very short and callous.

Bracts usually entire and obtuse, oblong to obovate, if 3-lobed with a broad middle lobe.

IV. RHEXIFOLIAE.

Bracts 3-cleft with lanceolate lobes, if entire very acute.

V. LANCIFOLIAE.

Leaves, at least the upper, pinnately cleft; bracts also cleft; lower corolla-lip not callous, larger.

VI. HISPIDAE.

Galea less than 3 times as long as the lip, rarely half as long as the corolla-tube; bracts in most species tinged with yellow or brown.

Leaves entire; bracts also entire or slightly 3-lobed.

VII. PALLIDAE.

Leaves pinnately divided, at least the upper ones.

VIII. LINEATAE.

Whole plant white-woolly.

Plant not white-woolly.

Corolla 1.5-3 cm. long, slightly exceeding the calyx.

IX. BRACHYANTHAE.

Corolla 4-5 cm. long, almost twice as long as the calyx.

X. SESSILIFLORAE.

I. STENANTHAE.

One species.

1. *C. exilis*.

II. LINARIÆFOLIAE.

Bracts crimson or pink.

Leaves all narrowly linear.

Upper leaves lanceolate.

Bracts yellow.

2. *C. linariaefolia*.

3. *C. Crista-galli*.

4. *C. cognata*.

III. INTEGRÆ.

Leaves entire.

Bracts oblong.

Bracts obovate.

Leaves pinnatifid.

5. *C. integra*.

6. *C. gloriosa*.

7. *C. Lindheimeri*.

IV. RHEXIFOLIAE.

Upper stem-leaves at least broadly lanceolate or oblong-ovate.

8. *C. rhexifolia*.

Leaves all narrowly lanceolate.

Bracts acute and usually deeply cleft, scarlet or crimson.

Bracts rounded at the apex, entire or with a short tooth on each side.

Bracts brownish or yellowish; leaves lanceolate, acute, densely puberulent.

10. *C. brunnescent*.

Bracts crimson or rose-color; leaves linear-lanceolate, acuminate, glabrous or nearly so at maturity.

11. *C. lauta*.

V. LANCIFOLIAE.

Calyx and upper part of the stem densely white-woolly. 12. *C. trinervis*.

Calyx and upper part of the stem sparingly hirsute-villous.

Plant growing more or less in clumps, with a short caudex.

9. *C. confusa*.

Stems solitary from a horizontal or ascending rootstock.

13. *C. lancifolia*.

VI. HISPIDAE.

Galea longer than the corolla-tube.

14. *C. chromosa*.

Galea shorter than the corolla-tube.

Bracts or their middle lobe very broad and rounded; calyx-lobes very short and rounded at the apex.

15. *C. obtusiloba*.

Bracts with narrow, lanceolate, oblong, or linear lobes.

Plant glabrous up to the inflorescence, 1-2 cm. high. 16. *C. Haydeni*.

Plant more or less pubescent, 3-6 dm. high.

Lobes of calyces, bracts and leaves narrowly linear; bracts brick-red.

17. *C. linearis*.

Lobes of bracts and calyces broader, lanceolate or oblong; bracts crimson.

18. *C. hispida*.

VII. PALLIDAE.

Plant 5-15 cm. high, densely villous above; corolla less than 2 cm. long; bracts varying from brownish-crimson to greenish-yellow.

19. *C. occidentalis*.

Plant 2-4 dm. high, slightly if at all villous; corolla usually 2 cm. long or more.

Stems solitary from a creeping rootstock; plant darkening in drying.

20. *C. luteovirens*.

Stems growing in clumps with a short caudex; plant rarely darkening in drying.

Upper leaves broadly lanceolate; all 3-ribbed; plant glabrous up to the inflorescence.

21. *C. sulphurea*.

All leaves linear, 1-ribbed or the uppermost linear-lanceolate and indistinctly 3-ribbed; plant puberulent.

22. *C. wyomingensis*.

VIII. LINEATAE.

One species.

23. *C. lineata*.

IX. BRACHYANTHAE.

Lower lip of the corolla fully half as long as the galea; plant less than 1 dm. high.

24. *C. puberula*.

Lower lip $\frac{1}{2}$ - $\frac{1}{3}$ as long as the galea; plant 3-4 dm. high.

Lower lip about $\frac{1}{2}$ as long as the galea; its lobes lanceolate, acuminate.

25. *C. brachyantha*.

Lower lip $\frac{1}{2}$ - $\frac{1}{4}$ as long as the galea; its lobes ovate, acute.

26. *C. flava*.

X. SESSILIFLORAE.

One species.

27. *C. sessiliflora*.

1. *Castilleja exilis* A. Nels. (*C. stricta* Rydb.; not DC.) In wet ground from Mont. and Wash. to Colo. and Nev.—Las Animas; Hotchkiss.

2. *Castilleja linariaefolia* Benth. In the mountains from Wyo. to N. M. and Calif.; also in Mex.—Alt. 6000-9000 ft.—Pike's Peak; near Empire; North Boulder Peak; headwaters of Clear Creek; southeast and west of Ouray; Parlin; Honnold; north of Mancos; Jack's Cabin; Cascade Cañon; Cerro Summit; West Indian Creek; Elk River, Routt Co.; Chicken Creek, West La Plata Mountains; Idaho Springs; Cucharas Valley, near La Veta; Twin Lakes; Veta Pass; Sangre de Cristo Creek; Pagosa Springs; La Veta; Soldier Cañon; Hotchkiss; Gypsum Creek Cañon; Baxter's ranch; Steam-

boat Springs; Narrows; Dolores; Beaver Creek; Horsetooth Gulch; Durango; Rist Cañon; Trapper's Lake; Graymont; Grand Lake; Poudre Cañon, Larimer Co.; Silverton; Empire.

3. *Castilleja Crista-galli* Rydb. In the mountains from Mont. to Colo.—Alt. 7000–10,000 ft.—Green Mountain Falls; South Cheyenne Cañon; Grayback mining camps and Placer Gulch; Eldora to Baltimore.

4. *Castilleja cognata* Greene. In the mountains of Colo.—Alt. about 8280 ft.—Jack's Cabin.

5. *Castilleja integra* A. Gray. Dry ground from Colo. to N. M. and Ariz.; also Mex.—Alt. 5000–10,000 ft.—Colorado Springs; Trail Glen; La Veta; Red Rock Cañon; Ojo; river-bluffs north of La Veta; Calhan; butte, 5 miles southwest of La Veta; hills southeast of La Veta; Piedra; Salida; near Denver; Como; Purgatory River, Trinidad; Palmer Lake; Table Rock; Cheyenne Cañon; Eldora to Baltimore; Colorado City.

6. *Castilleja gloriosa* Britton. In dry places from Colo. to Ariz.—Brantly Cañon.

7. *Castilleja Lindheimeri* A. Gray. In dry places from Colo. to Tex.—Alt. 4000–7000 ft.—Mancos; Grand Junction.

8. *Castilleja rhexifolia* Rydb. In the mountains from Alb. and Alaska to Colo.—Alt. 7000–14,000 ft.—Mt. Hesperus; Cameron Pass; Echo Creek, near La Veta; Marshall Pass; Mt. Hayden, La Plata Mountains; Mt. Harvard; Berthoud Pass.

9. *Castilleja confusa* Greene. In the mountains of Wyo. and Colo.—Alt. 6000–11,000 ft.—Georgetown; Red Mountain, south of Ouray; Bob Creek, west of Mt. Hesperus; Ruxton Park; Colorado Springs; Pike's Peak; Elk River, Routt Co.; Chicken Creek, west of Mt. Hesperus; Como; Little Veta Mountain; Upper La Plata River; Minnehaha; Little Kate Basin; mountains above Ouray; Beaver Creek; Rico; Michigan Hill; gulch east of Stove Prairie; Bosworth's ranch; Steamboat Springs; Empire; Eldora to Baltimore; Rabbit-Ears, Larimer Co.

10. *Castilleja brunnescens* Rydb. In the mountains of Colo. and Wyo.—Alt. 9000–11,000 ft.—Bush Creek, Custer Co.; Gray's Peak; Mancos; Red Mountain, south of Ouray; Pike's Peak; Taylor River; Cameron Pass; Hahn's Peak.

11. *Castilleja lauta* A. Nelson. (*C. oreopola subintegra* Fernald.) In the mountains from Mont. and Ore. to Colo.—Alt. 9000–12,000 ft.—Marshall Pass; Mt. Hesperus; Little Kate Basin; Cameron Pass; Alpine Tunnel; Graymont; Beaver Creek; Rico; Anita Peak.

12. *Castilleja trinervis* Rydb. In the mountain woods of Colo.—Alt. 8500–10,000 ft.—Columbine; headwaters of Pass Creek; headwaters of Sangre de Cristo Creek; Grayback mining camps and Placer Gulch.

13. *Castilleja lancifolia* Rydb. In mountains from Mont. and Alaska to Colo. and Ore.—Alt. 8000–12,000 ft.—Near Iron-ton, San Juan Co.; near Pagosa Peak; mountains between Sunshine and Ward; Berthoud Pass.

14. *Castilleja chromosa* A. Nelson. (*C. Stokesii* Brand.) In the mountains of Wyo. to Colo. and Calif.—Alt. about 8000 ft.—Cerro Summit.

15. *Castilleja obtusiloba* Rydb. In the mountains of Colo.—Alt. about 9000 ft.—Leroux Parks, Delta Co.

16. *Castilleja Haydeni* (A. Gray) Cockerell. (*C. pallida Haydeni* A. Gray) On the higher mountains of Colo.—Alt. about 12,300 ft.—Cumberland Mine, La Plata Mountains.

17. *Castilleja linearis* Rydb. In the mountains of Colo.—Alt. 8500–12,000 ft.—Gibb's Peak, Custer Co.; West Spanish Peak.

18. *Castilleja hispida* Benth. On hills and mountains from Mont. and Wash. to Colo. and Utah.—Alt. about 7500 ft.—Mountains, Larimer Co.; Dolores; Cimarron; Pinkham Creek.

19. *Castilleja occidentalis* Torr. (*C. pallida occidentalis* A. Gray) On the higher mountains from Alb. and B. C. to Colo.—Alt. 11,000–14,000 ft.—Near Empire; Pike's Peak; Gray's Peak; Ward; Mt. Ouray; Alpine Tunnel; Cameron Pass; Mt. Garfield; Berthoud Pass; Beaver Creek; Ethel Peak; summit of North Park Range, Routt Co.

20. *Castilleja luteovirens* Rydb. In mountain meadows from Wyo. and Colo.—Alt. 7000–9000 ft.—Headwaters of Clear Creek; Seven Lakes, near Pike's Peak; Veta Pass; Hamor's Lake, north of Durango; Chicken Creek, west of Mt. Hesperus; Sangre de Cristo Creek; Wahatoya Creek.

21. *Castilleja sulphurea* Rydb. In the mountains from S. D. and Wyo. to Colo. and Utah.—Alt. 7000–10,000 ft.—Rabbit-Ears, Larimer Co.; Mt. Harvard; Georgetown; Andrews' Shetland ranch; Grayback mining camps and Placer Gulch; Steamboat Springs; Cameron Pass; Columbine; Denver; Gunnison; Chambers' Lake; Ward; Ruxton Dell; North Park; Empire; Lake Moraine, Pike's Peak; Silver Plume; Graymont; Rico; Twin Lake; Walton Creek; Leroux Creek.

22. *Castilleja wyomingensis* Rydb. In the mountains from Mont. to Colo. and Utah.—Alt. 7500–9000 ft.—Wahatoya Creek; Red Mountain road, south of Ouray.

23. *Castilleja lineata* Greene. In the mountains of Colo.—Alt. 9000–10,000 ft.—West Spanish Peak; Pagosa Springs.

24. *Castilleja puberula* Rydb. In the mountains of Colo.—Alt. 8000–12,000 ft.—"Colorado"; Empire; Berthoud Pass.

25. *Castilleja brachyantha* Rydb. (*C. breviflora* A. Gray) In the mountains of Wyo. and Colo.—Alt. 8000–10,000 ft.—Headwaters of Clear Creek; North Park, near Teller; Grizzly Creek.

26. *Castilleja flava* S. Wats. In dry valleys from S. D., Mont. and B. C. to Colo. and Utah.—Alt. about 8000 ft.—Upper Laramie River; Pinkham Creek.

27. *Castilleja sessiliflora* Pursh. On dry plains from Ills. and Ass. to Mo., Tex. and Ariz.—Alt. 4000–7000 ft.—Table Rock; Ft. Collins; Colorado Springs; near Pueblo; Tobe Miller's ranch; Colorado City.

14. ORTHOCARPUS Nutt.

Corolla yellow; spike densely flowered; seeds costate.

1. *O. luteus*.

Corolla white, turning rose-purple; spike lax; seeds with a loose reticulate coat.

2. *O. purpureo-albus*.

1. *Orthocarpus luteus* Nutt. On dry plains and in sandy soil from Sask. and Wash. to Colo. and Nev.—Alt. 4000–10,000 ft.—Grizzly Creek; South Park; Georgetown; foot-hills, Larimer Co.; Pagosa Springs; Trimble

Springs, above Durango; Veta Mountain; Villa Grove; Garland; Silverton; Ruxton Dell; near Steamboat Springs; La Veta, west of Ouray; Gunnison; Table Rock; Middle Park; Horsetooth Gulch; Long Gulch; west of Soldier Cañon; Empire; between Sunshine and Ward.

2. *Orthocarpus purpureo-albus* A. Gray. In dry places from Colo. and Utah to N. M. and Ariz.—Durango; Piedra; La Plata and Mancos.

15. *ADENOSTEGIA* Benth.

1. *Adenostegia Kingii* (S. Wats.) Greene. (*Cordylanthus Kingii* S. Wats.) Dry ridges from Nev. to Colo.—Alt. 5500 ft.—San Juan Valley (*Brandegee*).

16. *ELEPHANTELLA* Rydb. LITTLE RED ELEPHANT.

1. *Elephantella groenlandica* (Retz.) Rydb. (*Pedicularis groenlandica* Retz.) In swamps and wet meadows from Greenl. and B. C. to Colo. and Calif.—Alt. 8000–12,000 ft.—Headwaters of Clear Creek; Cameron Pass; Silver Plume; Gray's Peak; Hamor's Lake, above Durango; Trapper's Lake; Seven Lakes; Central City; headwaters of Sangre de Cristo Creek; near Pagosa Peak; Pike's Peak; Alpine Tunnel; Cabin Cañon; Mirror Lake; Veta Pass; Mt. Harvard; Gore Pass; Eldora to Baltimore; Van Boxle's ranch, above Cimarron; Beaver Creek; summit of North Park Range, Routt Co.

17. *PEDICULARIS* L. LOUSEWORT.

Galea produced into a distinct beak.

Beak long, strongly incurved; lip very broad, meeting or inclosing the tip of the beak.

1. *P. racemosa*.

Beak short and straight; lip narrower and not meeting the tip of the galea.

2. *P. Parryi*.

Galea not produced into a distinct beak; but often with two lateral teeth near the apex.

Leaves pinnately divided or lobed.

Leaves divided to the midrib or nearly so into narrow, acute, dentate, serrate or incised divisions.

Galea toothless; plant 4–10 dm. high; lip not reaching the tip of the galea.

3. *P. bracteosa*.

Galea with two lateral teeth.

Plant tall, 3–15 dm. high; corolla sordid yellow, 3–3.5 cm. long; lip almost reaching the tip of the galea.

4. *P. Grayi*.

Plant lower, 1–4 dm. high; corolla purple, 2–2.5 cm. long; lip not reaching the tip of the galea.

5. *P. scopulorum*.

Leaves pinnately lobed (two-thirds to the midrib or less) with broadly oblong or rounded, obtuse and crenate lobes.

6. *P. canadensis*.

Leaves merely crenate.

7. *P. crenulata*.

1. *Pedicularis racemosa* Dougl. On wooded mountain sides from Mont. and B. C. to Colo. and Calif.—Alt. 8000–12,000 ft.—Headwaters of Clear Creek; Cameron Pass; Trapper's Lake; Berthoud Pass; Douglass Mountain, Georgetown; near Pagosa Peak; Marshall Pass; Mt. Abram, Ouray; Beaver Creek; Boreas; bank of Michigan; Leroux Park; Eldora to Baltimore; Bufalo Pass; Anita Peak; Rabbit-Ear Range.

2. *Pedicularis Parryi* A. Gray. On the higher mountains from Wyo. to Colo. and Utah.—Alt. 8000–12,000 ft.—South Park; Pike's Peak; headwaters of Clear Creek; Empire; North Park near Teller; Como, South Park; Little

Kate Basin, La Plata Mountains; Seven Lakes; Cameron Pass; Marshall Pass; Alpine Tunnel; Beaver Creek; Berthoud Pass.

3. *Pedicularis bracteata* Benth. In wet places in the mountains from Alb. and B. C. to Colo. and Utah.—Alt. 9000–12,000 ft.—Marshall Pass; Cameron Pass; near Pagosa Peak; Tennessee Pass, 7 miles west of Leadville; Mt. Hesperus; Leroux Parks, Delta Co.; Upper La Plata River; Beaver Creek; Berthoud Pass; summit of North Park Range, Larimer Co.

4. *Pedicularis Grayi* A. Nels. (*P. procera* A. Gray) In wooded ground in the mountains of Wyo. and Colo.—Alt. 8000–13,000 ft.—Near Empire; Cameron Pass; headwaters of Clear Creek; Andrews' Shetland ranch; Bear Lake Cañon; Georgetown; Silver Plume; Upper La Plata Cañon; Como; South Park; West Spanish Peak; near Pagosa Peak; Bear Creek Cañon, near Colorado Springs; Buena Vista; Veta; Pike's Peak; Hamor's Lake; Ruxton Park; gulch south of Steamboat Springs; Hotchkiss; Bosworth's ranch; Stove Prairie; Empire.

5. *Pedicularis scopulorum* A. Gray. On the higher peaks of Colo.—Alt. 10,000–13,000 ft.—South Park; Mt. Abram, Ouray; Gray's Peak.

6. *Pedicularis canadensis* L. In mountain meadows and moist woodlands from N. S., Man. and Wyo. to Fla. and N. M.—Alt. 6000–9000 ft.—Pike's Peak; North Cheyenne Cañon; headwaters of Sangre de Cristo Creek; Crystal Park; Veta Pass; Cucharas River, below La Veta; Table Rock.

7. *Pedicularis crenulata* Benth. In meadows and parks of Wyo. and Colo.—Alt. 7000–10,000 ft.—Gunnison; Sapinero; Parlin; South Park; Westcliffe; Buena Vista; Como, South Park; Sand Creek Pass; Walden.

18. RHINANTHUS L. YELLOW-RATTLE.

1. *Rhinanthus Crista-galli* L. On wooded hills and in meadows from Lab. and Alaska to N. Y., N. M. and Ore.; also in Europe.—Pagosa Springs.

Family 121. PINGUICULACEAE Dumort. BLADDERWORT FAMILY.

1. UTRICULARIA L. BLADDERWORT.

Leaves 2–3 times pinnately divided with long divisions; corolla about 12 mm. wide; spur prominent, elongated-conical, curved. 1. *U. vulgaris*.

Leaves dichotomously divided with very short divisions; corolla 4–6 mm. wide; spur a mere protuberance. 2. *U. minor*.

1. *Utricularia vulgaris* L. In water from Newf. and Alaska to Fla. and Calif.; also in Europe.—Alt. 8000–12,000 ft.—Rio Grande, Alamosa; Parlin; Seven Lakes; Estes Park.

2. *Utricularia minor* L. In water from Greenl. and B. C. to N. J., Colo. and Calif.; also in Europe.—Near Grand Lake.

Family 122. OROBANCHACEAE Lindl. BROOM-RAPE FAMILY.

Flowers subtended by bractlets.

Flowers without bractlets.

1. MYZORRHIZA.

2. THALESIA.

1. **MYZORRHIZA** Philippi. BROOM-RAPE.

Corolla 20-25 mm. long; anthers woolly.

1. *M. multiflora*.

Corolla 15-18 mm. long; anthers glabrous.

2. *M. ludoviciana*.

1. *Myzorrhiza multiflora* (Nutt.) Rydb. (*Orobranche multiflora* Nutt.; *Aphyllon multiflorum* A. Gray) In sandy soil from Colo. and Utah to Tex. and Ariz.—Along the McElmo; Dixon Cañon.

2. *Myzorrhiza ludoviciana* (Nutt.) Rydb. (*O. Ludoviciana* Nutt.; *Aphyllon Ludovicianum* A. Gray) In sandy soil from Ills. and Wash. to Tex. and Calif.—North Denver, near Argos (*Eastwood*).

2. **THALESIA** Raf. CANCER-ROOT.

1. *Thalesia fasciculata* (Nutt.) Britton. Parasitic on Composites, especially *Artemisia frigida*, from Ind. and Yukon to Colo. and Calif.; also Mex.—Alt. 4000-11,000 ft.—Near Boulder; Silver Plume; West Spanish Peak; Como, South Park; Salida; Garden of the Gods; Table Mountain; Golden; Arboles; Ft. Collins; Dolores; Table Rock; Fossil Creek; Quimby; Soldier Cañon.

Family 123. **MARTYNIACEAE** Link. UNICORN-PLANT FAMILY.1. **MARTYNIA** L. UNICORN-PLANT; RAM'S-HORN.

1. *Martynia Louisiana* Mill. (*M. proboscoidea* Glox.) In waste places from Me. and Iowa to N. C. and Colo.—Ft. Collins; Cañon City.

Order 45. **PLANTAGINALES**.Family 124. **PLANTAGINACEAE** Lindl. PLANTAIN-FAMILY.1. **PLANTAGO** L. PLANTAIN.

Flowers all perfect; corolla not closed over the fruit; stamens 4.

Leaves lanceolate to ovate; neither leaves nor spike silky-pubescent; stamens in all the flowers long-exserted.

Spike cylindrical; seeds not concave on the faces.

Leaves ovate, abruptly contracted at the base; seeds more than 2 in each cell.

Pyxis dehiscent at the middle, rounded-ovoid, obtusish; leaves usually thick and the dense spike obtuse.

1. *P. major*.

Pyxis dehiscent far below the middle, elongated-ovoid, very acute; leaves thin and the lax spike acute.

2. *P. asiatica*.

Leaves lanceolate, gradually tapering into the petioles; seed not more than 2 in each cell.

Leaves thin; plant not woolly at the base.

3. *P. Tweedyi*.

Leaves thick; plant with red or brown wool at the base.

4. *P. eriopoda*.

Spike short, oblong, 1-3 cm. long; seeds concave on the faces; leaves narrowly lanceolate.

5. *P. lanceolata*.

Leaves linear; leaves and peduncles pubescent with long silky hairs; anther in the more fertile flowers included; seeds solitary in each cell; concave on the faces.

6. *P. Purshii*.

Flowers subdioecious or polygamo-dioecious; corolla in the fertile plant remaining closed or early closing over the capsule; stamens 2; leaves filiform.

7. *P. myosuroides*.

1. *Plantago major* L. In waste places and around dwellings from Newf. and B. C. to Fla. and Calif.; naturalized from Europe.—Georgetown; along Uncompahgre River, near Ouray; Ft. Collins.
2. *Plantago asiatica* L. In waste places and sandy soil from Ass. and B. C. to Colo.; also Eastern Asia.—Alt. 5000–8000 ft.—Parlin; Arboles; Ft. Collins.
3. *Plantago Tweedyi* A. Gray. On grassy slopes from Mont. to Colo. and Utah.—Alt. up to 10,000 ft.—Chambers' Lake; Rabbit-Ears Pass; Buffalo Pass; Gore Pass.
4. *Plantago eriopoda* Torr. (*P. retrorsa* Greene) In saline soil from Que. and Mont. to Colo. and Nev.—Alt. 4000–8500 ft.—La Porte; Doyle's; bank of Canadian River.
5. *Plantago lanceolata* L. In waste places and around dwellings from N. B. and Wash. to Fla. and Calif.; naturalized from Europe, but rare in the Rocky Mountain region.—Alt. up to 5000 ft.—Ft. Collins.
6. *Plantago Purshii* R. & S. On plains, prairies and in river valleys, especially in sandy or poor soil from Ont., Ass. and Wash. to Mo., Tex. and Ariz.—Alt. 4000–10,000 ft.—Golden; Ft. Collins; Colorado Springs; Monument Park; Denver; Trinidad; West Spanish Peak; Veta Pass; Walsenburg; New Windsor; Pueblo; Quimby; Wray; Table Rock; Grand Junction.
7. *Plantago myosuroides* Rydb. In sandy soil from Ass. and S. D. to Neb. and Utah.—Grand Junction.

Order 46. RUBIALES.

Stamens as many as the corolla-lobes.

Leaves with stipules (in ours leaf-like and usually regarded as leaves) adnate to the stem between the leaf bases. 125. RUBIACEAE.

Leaves without stipules or if present these adnate to the petioles.

126. CAPRIFOLIACEAE.

Stamens twice as many as the corolla-lobes; low herbs with ternately dissected leaves. 127. ADOXACEAE.

Family 125. RUBIACEAE Juss. MADDER FAMILY.

1. GALIUM L. BEDSTRAW.

Flowers perfect; fruit hirsute with uncinat hairs or glabrous.

Annuals.

Stem coarse, reclining; leaves (i. e., leaves and stipules), 6–8 in the whorls.

Leaves linear or oblanceolate.

Leaves 2–7 cm. long; nutlets when ripe 3–5 mm. in diameter; flowers white. 1. *G. Aparina*.

Leaves 0.5–2 cm. long; nutlets when ripe 2–3 mm. in diameter; flowers ochroleucous. 2. *G. Vaillantii*.

Leaves elliptic.

9. *G. flaviflorum*.

Stem slender, erect or ascending; leaves 4 in the whorls.

Leaves ovate or oblong, 5–7 mm. long; fruit nearly sessile.

Leaves linear-oblong or linear, often 10–20 mm. long; fruit distinctly peduncled. 3. *G. proliferum*.

Leaves linear-oblong or linear, often 10–20 mm. long; fruit distinctly peduncled. 4. *G. bifolium*.

Perennials.

Leaves not cuspidate-pointed.

Stem stout; leaves thick, 3-nerved.

5. *G. boreale*.

Stem very slender; leaves 1-nerved.

Leaves obovate to broadly oblong-obovate, somewhat fleshy.

Petals almost 1 mm. long; pedicels and generally also stem glabrous.

6. *G. Brandegei*.

Petals about 0.5 mm. long; pedicels and stem more or less scabrous.

7. *G. subbiflorum*.

Leaves linear-oblong or linear-oblancoelate.

8. *G. trifidum*.

Leaves cuspidate-pointed.

Stem retrorse-bristly; pedicels scarcely exceeding the bracts.

9. *G. flaviflorum*.

Stem glabrous or sparingly hirsute; pedicels much exceeding the small bract.

10. *G. triflorum*.

Flowers in ours dioecious; fruit with long hairs, not uncinat; perennials.

11. *G. coloradense*.

1. *Galium Aparine* L. In shady places from N. B. and Alaska to Fla. and Calif.; also in Europe and Asia.—Alt. 4000-6000 ft.—Horsetooth Gulch; Rist Cañon; Ft. Collins; foot-hills, Larimer Co.

2. *Galium Vaillantii* DC. (*G. Aparine Vaillantii* Koch.) Among bushes and in shady places from Mont. and B. C. to Mex.—Alt. 5000-8000 ft.—Spring Cañon; Rist Cañon; butte, 5 miles southwest of La Veta.

3. *Galium proliferum* A. Gray. On stony hills from Colo. to Tex. and N. M.; also Mex.—Locality not given.

4. *Galium bifolium* S. Wats. In wet places in the mountains from Mont. and Wash. to Colo. and Calif.—Alt. about 7500 ft.—HonnoId; Steamboat Springs.

5. *Galium boreale* L. On rocky banks and hillsides, especially among bushes, from Que. and Alaska to N. J., Mo., Colo. and Calif.—Alt. 4000-10,000 ft.—Rist Cañon; foot-hills, Larimer Co.; Hotchkiss; Baxter's ranch; Barnes' Camp; Table Rock; Ft. Collins; Stove Prairie Hill; gulch west of Pennoek's; Pike's Peak; west of Ouray; Dillon; Veta Pass; Parlin; Gunnison; Minnehaha; Pagosa Springs; Grayback mining camps and Placer Gulch; Narrows; Andrews' Shetland ranch; Four-mile Hill, Routt Co.; Mancos; Golden; Clear Creek Cañon; North Cheyenne Cañon; Bear Creek Cañon; Cumbres; Moon's ranch; Glenwood Springs; between Sunshine and Ward; Fish Creek Falls.

6. *Galium Brandegei* A. Gray. In moist ground from Wyo. to N. M. and Calif.—Alt. 6000-10,000 ft.—Columbine; twelve miles below Grand Lake; Steamboat Springs; Chambers' Lake.

7. *Galium subbiflorum* (Wieg.) Rydb. (*G. trifidum subbiflorum* Wieg.) In cold bogs and wet places from Minn. and Ida. to Colo. and Calif.—Alt. 8000-10,000 ft.—Beaver Creek; Empire.

8. *Galium trifidum* L. In swamps and wet meadows from Newf. and Ida. to Colo. and Utah.—Alt. up to 8000 ft.—Parlin; Beaver Creek.

9. *Galium flaviflorum* Heller. In cañons of Colo. and N. M.—Alt. 7500-8500 ft.—Box Cañon, west of Ouray.

10. *Galium triflorum* Michx. In open woods from Newf. and Alaska to Ala. and Calif.—Alt. 6000-9000 ft.—Boulder Cañon; Red Mountain road, south of Ouray; Ruxton Brook; headwaters of Pass Creek; near Pagosa Peak; Columbine; vicinity of Pine Grove; Bosworth's ranch; Four-mile Hill; Ouray.

11. *Galium coloradense* Wright. (*G. Mathewsii* A. Gray, in part) On arid grounds in southern Colo.—Alt. 7000-8000 ft.—Black Cañon; Mesa Verde; Mancos; Glenwood Springs.

Family 126. **CAPRIFOLIACEAE** Vent. **HONEYSUCKLE FAMILY.**

Style deeply 3-5-cleft; shrubs or trees with compound cymose inflorescence and drupaceous fruit.

Leaves pinnate; ovary 3-5-celled, each cell with 1 ovule. 1. *SAMBUCUS*.

Leaves simple; ovary 1-celled and 1-ovuled.

2. *VIBURNUM*.

Style slender, undivided; stigma capitate.

Trailing evergreen herb; flowers long-peduncled, geminate; stamens 4, didynamous. 3. *LINNAEA*.

Shrubs; stamens generally 5.

Corolla rarely gibbous at the base, regular or nearly so. 4. *SYMPHORICARPOS*.

Corolla gibbous at the base, irregular and bilabiate. 5. *DISTEGIA*.

1. **SAMBUCUS** L. **ELDER.**

Cyme not flat-topped, thyrsoid-paniculate; the axis continuous.

Fruit red or rarely yellow.

1. *S. microbotrys*.

Fruit black.

2. *S. melanocarpa*.

Cyme flat-topped, umbelliform, 4-5-rayed; the rays again variously compound; fruit blackish.

3. *S. neo-mexicana*.

1. *Sambucus microbotrys* Rydb. On hillsides from S. D. and Wyo. to Colo. and Ariz.—Alt. 7500-12,000 ft.—Gore Pass; above Beaver Creek; Marshall Pass; Bob Creek, West La Plata Mountains; Jack Brook; west of Ouray; Iron-ton Park, nine miles south of Ouray; Front Range, Larimer Co.; Ojo; Villa Grove; Halfway House; Pike's Peak; Gray's Peak; Little Veta Mountain; East Indian Creek; Bottomless Pit, Pike's Peak; Lake City; Red River, Franklin Co.; between Sunshine and Ward.

2. *Sambucus melanocarpa* A. Gray. In cañons and ravines from Alb. and Ida. to Colo. and Ore.—Alt. about 9000 ft.—Headwaters of Pass Creek; Clear Creek Cañon; Fish Creek Falls; Pinkham Creek.

3. *Sambucus neo-mexicana* Woot. In the mountains of Colo., N. Mex. and Ariz.—Silver Plume.

2. **VIBURNUM** L. **ARROW-WOOD, SNOW-BALLS.**

Leaves palmately veined, usually 3-lobed; fruit red.

1. *V. pauciflorum*.

Leaves pinnately veined, not lobed; fruit blue or black.

2. *V. Lentago*.

1. *Viburnum pauciflorum* Pylaie. In woods from Lab. and Alaska to Pa., Colo. and Wash.—Alt. about 8000 ft.—Grand Lake; Minnehaha; Clear Creek.

2. *Viburnum Lentago* L. In wood and on banks of streams from Me. and Man. to Ga. and Colo.—Gulch south of Boulder.

3. **LINNAEA** Gron. **TWIN-FLOWER, GROUND-VINE.**

1. *Linnaea americana* Forbes. (*L. borealis* Michx.; not L.) In cold woods from Greenl. and Alaska to N. J., Mich., Colo. and Utah.—Alt. 8000-13,000 ft.—Beaver Creek; Graymont; Grand Lake; Chambers' Lake; Gray's Peak; West Spanish Peak; Front Range, Larimer Co.; South Boulder Peak.

4. **SYMPHORICARPOS** L. **SNOW-BERRY, CORAL-BERRY.**

Corolla short; open-campanulate.

Fruit red; style bearded.

1. *S. Symphoricarpos*.

Fruit white; style glabrous.

Style and stamens somewhat exserted; leaves thick.

2. *S. occidentalis*.

Style and stamens not exserted; leaves rather thin.

3. *S. pauciflorus*.

Corolla elongated, oblong-campanulate to salverform.

Corolla oblong-campanulate, 6-8 mm. long.

Leaves decidedly pubescent; stem puberulent; leaves rounded-oval, obtuse or rounded at the apex.

4. *S. rotundifolius*.

Leaves glabrate or slightly pubescent.

Leaves rounded-ovate or rounded-oval, 3-4 cm. long.

5. *S. utahensis*.

Leaves oval, acute, 1-2 cm. long.

6. *S. vaccinioides*.

Corolla tubular-funnelform, 8-12 mm. long.

7. *S. oreophilus*.

1. *Symphoricarpos* *Symphoricarpos* (L.) MacM. (*S. vulgaris* Michx.) Along rivers and in rocky places from N. Y. and Wyo. to Ga., Tex. and Colo.—Manitou.

2. *Symphoricarpos occidentalis* Hook. Hillsides from Mich., Mackenzie and B. C. to Mo. and Colo.—Alt. 4000-8000 ft.—Poudre Cañon; Baxter's ranch; Ft. Collins; Stove Prairie Hill; Pueblo; Cañon City; Denver; Ft. Collins; Livermore; Echo Creek; Colorado Springs; Boulder; between Sunshine and Ward.

3. *Symphoricarpos pauciflorus* (Robbins) Britton. (*S. racemosus pauciflorus* Robbins) In rocky places and on hillsides from Vt. and B. C. to Pa., Colo. and Calif.—Gypsum; Howe's Gulch; Horsetooth Mountain; North Cheyenne Cañon; west of Ft. Collins; Middle Park; Dillon Cañon.

4. *Symphoricarpos rotundifolius* A. Gray. In the mountains from Wyo. and Ida. to N. M.—Spicer, Larimer Co.

5. *Symphoricarpos utahensis* Rydb. On hillsides from Wyo. and Ida. to Colo. and Utah.—Alt. about 8000 ft.—Van Boxle's ranch, above Cimarron.

6. *Symphoricarpos vaccinioides* Rydb. On hillsides from Mont. and Wash. to Colo. and Nev.—Alt. about 7000 ft.—Wolcott, Eagle Co.; Cimarron.

7. *Symphoricarpos oreophilus* A. Gray. In the mountains from Colo. and Utah to N. M. and Ariz.—Alt. 7500-10,000 ft.—Divide road to Steamboat Springs; near Ouray; Pitkin; southeast of Ouray; Durango; Georgetown; West Mancos Cañon; Grayback mining camps and Placer Gulch; on Turkey Creek and tributaries; near Pagosa Peak; Gunnison; Wolcott, Eagle Co.; Clear Creek; Eldora to Baltimore.

5. DISTEGIA Raf.

1. *Distegia involucrata* (Richardson) Rydb. (*Lonicera involucrata* Banks) In wet woodlands from Que. and Alaska to Mich., Colo. and Calif.; also Mex.—Alt. 7000-9000 ft.—Gulch south of Rist Cañon; Mancos; Gunnison; Mt. Hesperus; Los Pinos (Bayfield); near Pagosa Peak; Glenwood Springs; foot-hills, Larimer Co.; Andrews' Shetland ranch; Wahatoya Cañon; East Indian Creek; South Park; near Ironton, San Juan Co.; Sapinero; Gunnison; Parlin; Box Cañon, west of Ouray; Red Mountain road, south of Ouray; Veta Pass; Eldora to Baltimore; mountains between Sunshine and Ward; Beaver Creek.

Family 127. ADOXACEAE Fritch. MOSCHATEL FAMILY.

1. ADOXA L. MUSK-ROOT, MOSCHATEL

1. *Adoxa Moschatellina* L. In shady, wet, rocky places from Arctic America to Wisc. and Colo.—Alt. 7000-12,000 ft.—Carson; Seven Lakes; Gentian

Ridge; Pike's Peak; West Spanish Peak; Bottomless Pit, Pike's Peak; near Pagosa Peak; Tennessee Pass, seven miles west of Leadville; Front Range, Larimer Co.; Mt. Hesperus; Clear Creek; Boulder Cañon.

Order 47. CAMPANULALES.

Endosperm wanting; flowers monoecious or dioecious; plant mainly vines with tendrils. 128. CUCURBITACEAE.

Endosperm present; flowers perfect; plants (at least ours) not vines.

Corolla regular.

129. CAMPANULACEAE.

Corolla split on one side and more or less irregular.

130. LOBELIACEAE.

Family 128. CUCURBITACEAE Juss. GOURD FAMILY.

Ovary 1-celled with 3-5 placentae; ovules numerous; corolla campanulate; fruit fleshy, indehiscent. 1. CUCURBITA.

Ovary 2-celled; ovules few; fruit opening at the top; corolla rotate, small.

2. MICRAMPELIS.

1. CUCURBITA L. GOURD, PUMPKIN.

1. *Cucurbita foetidissima* H. B. K. (*C. perennis* A. Gray) On plains from Mo. and Neb. to Tex. and Calif.—Bank of Arkansas River.

2. MICRAMPELIS Raf. BALSAM APPLE; MOCK APPLE.

1. *Micrampelis lobata* (Michx.) Greene. (*Echinocystis lobata* T. & G.) On river banks among shrubs from Me. and Mont. to Va. and Colo.—Ft. Collins; Cache la Poudre; Platte River, near Denver.

Family 129. CAMPANULACEAE Juss. BELLFLOWER FAMILY.

Corolla campanulate or funnelform; inflorescence racemose or paniculate; flowers complete throughout. 1. CAMPANULA.

Corolla rotate; inflorescence spicate; flowers of two kinds; the earlier cleistogamous. 2. SPECULARIA.

1. CAMPANULA L. BELLFLOWER, BLUEBELL, HAREBELL.

Flowers over 1 cm. long; plant simple or with erect or ascending branches.

Capsule erect, opening by pores near the summit, just below the base of the sepals.

Hypanthium and pod club-shaped, constricted just below the sepals, often hairy; leaves entire; sepals obtuse. 1. *C. uniflora*.

Hypanthium and pod turbinate, not constricted; sepals acuminate.

2. *C. Parryi*.

3. *C. petiolata*.

Capsule nodding, opening by pores near the base.

Flowers 5-8 mm. long; stem retrorse-hispid with divaricate branches.

4. *C. aparinoides*.

1. *Campanula uniflora* L. In arctic-alpine localities from Greenl. and Alaska to Lab., Colo. and Utah.—Mountains of Estes Park.

2. *Campanula Parryi* A. Gray. In mountain valleys from Wyo. and Utah to N. M. and Ariz.—Alt. 8000-12,000 ft.—Table Rock; Sand Creek; Como and vicinity; Happy Hollow; Beaver Creek; Clear Creek, near Elizabethtown; Hematite; Eldora to Baltimore; Empire.

3. *Campanula petiolata* DC. (*C. rotundifolia* American authors, in part; not L.) On hills and mountains from Mackenzie and Wash. to N. M. and Utah.—Alt. 5000–12,000 ft.—Gunnison Co.; Gray's Peak; Rist Cañon; Breckenridge; Narrows; near Ft. Collins; Horsetooth Gulch; Palmer Lake; Dillon Cañon; Trinidad; Howe's Gulch; gulch west of Soldier Cañon; Boulder.

4. *Campanula aparinoides* Pursh. In wet meadows from N. B. and Sask. to Ga. and Colo.—Along Platte, near Denver (*Eastwood.*).

2. **SPECULARIA** Heist. VENUS' LOOKING-GLASS.

Leaves cordate-clasping; capsule oblong.

1. *S. perfoliata*.

Leaves linear or linear-lanceolate; capsule linear-cylindric.

2. *S. leptocarpa*.

1. *Specularia perfoliata* (L.) A. DC. On hillsides from Me. and B. C. to Fla., Ariz. and Ore.; also in Mex.—Spring Cañon; Howe's Gulch; Horsetooth Gulch; Platte River.

2. *Specularia leptocarpa* (Nutt.) A. Gray. In dry soil from Mo. and Mont. to Tex. and Colo.—Locality not given.

Family 130. **LOBELIACEAE** Dumort. LOBELIA FAMILY.

1. **LOBELIA** L. LOBELIA, CARDINAL-FLOWER.

1. *Lobelia syphilitica* L. In wet places from Me. and S. D. to Ga., La. and Colo. West of the Missouri River it is only represented by the smaller var. *Ludoviciana* A. DC.—Vicinity of Ft. Collins; hills north of La Porte; Denver.

Order 48. **VALERIANALES.**

Family 131. **VALERIANACEAE** Batsch. VALERIAN FAMILY.

1. **VALERIANA** L. VALERIAN.

Leaves thick, entire or with linear, entire divisions; veining almost parallel.

Fruit and ovaries pubescent; bracts in the staminate plant linear-lanceolate.

1. *V. edulis*.

Fruit glabrous, scurfy, muricate or rugose.

Basal leaves oblanceolate; fruit broadly ovate; corolla of the staminate plant 2.5–3 mm. wide; root thick.

2. *V. trachycarpa*.

Basal leaves narrowly linear-oblanceolate; fruit narrowly ovate; corolla of the staminate flowers less than 2 mm. wide; root rather slender.

3. *V. furfurascens*.

Leaves thin; the cauline ones pinnate; veining distinctly pinnate.

Ovary and fruit at least when young pubescent.

4. *V. micrantha*.

Ovary and fruit glabrous.

Basal leaf-blades ovate-cordate.

5. *V. ovata*.

Basal leaf-blades spatulate, oval or lanceolate, tapering at the base.

Lateral leaflets or lobes of the stem-leaves small, linear-lanceolate, acuminate.

6. *V. acutiloba*.

Lateral leaflets of the stem-leaves ample, ovate to lanceolate, acute.

7. *V. occidentalis*.

1. *Valeriana edulis* Nutt. On hillsides and dry meadows from Ida. and Mont. to Colo. and Utah.—Alt. up to 11,000 ft.—Berthoud Pass; Continental Divide; Columbine; Conejos River, north of Antonito.

2. *Valeriana trachycarpa* Rydb. In the mountains of Colo. and N. M.—Alt. 8000-10,000 ft.—Red Mountain; Alpine Tunnel; Marshall Pass; Rabbit-Ears Pass.
3. *Valeriana furfurascens* A. Nelson. On hillsides and mountains of Wyo. and Colo.—Alt. 7000-10,000 ft.—Bosworth's ranch; Narrows; Pike's Peak; Ruxton Dell; Indian Pass Creek.
4. *Valeriana micrantha* A. Nelson. In the mountains from Mont. and Ida. to Colo. and Utah.—Alt. about 9000 ft.—West Mancos Cañon; Rabbit-Ears, Larimer Co.
5. *Valeriana ovata* Rydb. In the mountains of Colo. and N. Mex.—Alt. up to 9500 ft.—Cameron's Cone.
6. *Valeriana acutiloba* Rydb. (*V. oreophila* Greene) In the mountains from Wyo. and Utah to N. M. and Ariz.—Alt. 8000-13,500 ft.—Silverton; Beaver Creek; mountains about Ouray; mountains above Graymont; Ragged Mountains; Cameron Pass; Pike's Peak; Clear Creek; mountain near Veta Pass; near Pagosa Peak; Bear Creek Cañon; Mt. Hesperus; Mt. Abram, Ouray; Ruxton Dell; Gray's Peak; Carson; Grayback mining camps and Placer Gulch; Salida; Boreas; Mt. Richtofen.
7. *Valeriana occidentalis* Heller. In wet places in the mountains from Ida. and Mont. to Colo. and Utah.—Cañon of Cache la Poudre; Poverty Ridge, above Cimarron; Anita Peak; Beaver Creek.

Order 49. CARDUALES.

Flowers all with tubular corollas or none, or only the ray-flowers with ligulate corollas.

Stamens distinct; flowers unisexual.

132. AMBROSIACEAE.

Stamens united by the anthers, or if distinct (in *Kuhnia*) the flowers hermaphrodite.

133. CARDUACEAE.

Flowers all with ligulate corollas.

134. CICHORIACEAE.

Family 132. AMBROSIACEAE Reich. RAGWEED FAMILY.

Staminate and pistillate flowers in the same heads; the latter few (rarely solitary or none), at the margins.

Achenes turgid, ovoid or pear-shaped, marginless.

Involucres of 5 dilated ovate, rigidly acuminate bracts; achenes with a large terminal areola, surrounded by a disk.

1. OXYTENIA.

Involucres not with dilated rigidly acuminate bracts; terminal areola minute.

2. IVA.

Achenes flattened, wing-margined; involucres of 5 ovate or oblong herbaceous bracts and within them 1-2 large scarious bracts subtending the pistillate flowers.

3. DICORIA.

Staminate and pistillate flowers in different heads; the latter 1-4, without corolla, and enclosed in a nut-like or burr-like involucre.

Involucres of the staminate heads with united bracts; receptacles low; rudimentary styles penicillate or fimbriate at the apex.

Spines or tubercles of the 1-flowered pistillate heads in a single row.

4. AMBROSIA.

Spines of the 1-4-flowered pistillate heads in more than one row.

5. GAERTNERIA.

Involucres of the staminate heads with distinct bracts; receptacle cylindrical; spines of the 2-flowered pistillate heads in several rows, uncinate.

6. XANTHIUM.

1. **OXYTENIA** Nutt.

1. *Oxytenia acerosa* Nutt. On dry plains from Colo. to N. M. and Ariz.—Alt. about 4500 ft.—San Juan Valley.

2. **IVA** L. MARSH ELDER.

Heads paniculate; leaves ovate, canescent beneath.
Heads axillary; leaves obovate or oblong, green.

1. *I. xanthifolia*.
2. *I. axillaris*.

1. *Iva xanthifolia* Nutt. In moist soil, along streams and in waste places from Mich., Sask. and Wash. to Neb. and N. M.—Alt. 4000-7000 ft.—Sunset Cañon; Cheyenne Mountain; Ft. Collins; Huerfano Valley, near Gardner; Poudre River.

2. *Iva axillaris* Pursh. In alkaline or saline meadows from Sask. and B. C. to Ind. Terr. and Calif.—Alt. 4000-7000 ft.—Gunnison; near Greeley; Grand Junction; Calhan; Ft. Collins; Lamar.

3. **DICORIA** T. & G.

1. *Dicoria Brandegei* A. Gray. On sandy bottoms from Colo. and Utah to Ariz.—San Juan River; between McElmo and Recapture Creeks.

4. **AMBROSIA** L. RAG-WEED, HOG-WEED.

Involucres of the staminate heads 3-ribbed; leaves palmately 3-5-cleft or entire.

1. *A. trifida*.

Involucres of the staminate heads not ribbed; leaves once to thrice pinnatifid.

Annual; fruit with acute teeth.

2. *A. artemisiifolia*.

Perennial; fruit with blunt teeth or unarmed.

3. *A. psilostachya*.

1. *Ambrosia trifida* L. In moist soil from Que. and Ass. to Fla. and Colo.—Alt. 4000-5000 ft.—East of Windsor; Ft. Collins; Dixon Cañon; Poudre Cañon.

Ambrosia trifida integrifolia (Muhl.) T. & G. A variety with entire leaves. Together with the species.—Cache la Poudre River.

2. *Ambrosia artemisiifolia* L. In dry soil, waste places and fields from N. S. and B. C. to Fla. and Colo.—Alt. 4000-5000 ft.—Ft. Collins; banks of the Poudre.

3. *Ambrosia psilostachya* DC. On prairies and plains from Ills., Sask. and Ida. to La. and Calif.; also in Mex.—Alt. 4000-7000 ft.—Golden; New Windsor; Garden of the Gods; Pagosa Springs; Boulder; Lyons; Ft. Collins.

5. **GAERTNERIA** Med.

Leaves twice or thrice pinnately dissected.

Leaves regularly pinnate with linear or oblong divisions.

Staminate involucres cleft below the middle; root mostly annuals.

1. *G. acanthocarpa*.

Staminate involucres not cleft to the middle; perennials.

Divisions of the leaves oblong or oblong-linear, acute.

2. *G. tenuifolia*.

3. *G. linearis*.

Divisions of the leaves linear, obtuse.

Leaves interruptedly pinnate; divisions ovate or triangular.

4. *G. tomentosa*.

5. *G. Grayi*.

Leaves simply pinnate or simple.

1. *Gaertneria acanthocarpa* (Hook.) Britton. (*Franseria Hookeriana* Nutt.) On plains and in sandy valleys from Sask. and B. C. to Tex. and Calif.—Alt. 4000–8000 ft.—Colorado Springs; Denver; Huerfano Valley, near Gardner; Buena Vista; Grand Junction; Delta; Rocky Ford; Grand River.

2. *Gaertneria tenuifolia* (A. Gray) Kuntze. (*Franseria tenuifolia* A. Gray) In moist ground from Kans. and Colo. to Tex. and Calif.; also in Mex.—Exact locality not given.

3. *Gaertneria linearis* Rydb. Dry plains of Colo.—Alt. about 7000 ft.—Calhan.

4. *Gaertneria tomentosa* (Nutt.) Heller. (*Ambrosia tomentosa* Nutt.; *Franseria discolor* Nutt.) In dry soil from S. D. and Wyo. to Kans. and N. M.—Alt. 4000–6000 ft.—Platte River; Ft. Collins; New Windsor; Boulder.

5. *Gaertneria Grayi* Heller. (*Franseria tomentosa* A. Gray) River valleys in Kans., Neb. and Eastern Colo.—Exact locality not given.

6. XANTHIUM L. COCKLEBUR.

1. *Xanthium commune* Britton. In valleys from Que. and N. Y. to Utah and Ariz.—Ft. Collins.

Family 133. CARDUACEAE Necker. THISTLE FAMILY.

Stigmatic lines at the base of the stigmas or below the middle; heads always discoid, never yellow or brown; anthers not caudate at the base.

Stigma filiform or subulate, hispidulous. Tribe 1. VERNONIAE.

Stigmas more or less clavate, papillose-puberulent. Tribe 2. EUPATORIAE.

Stigmatic lines extending to the tips of the stigmata or to the appendage thereof, if present.

Anther-sacs not tailed at the base; heads most commonly radiate and with yellow or brown disk-flowers.

Stigmata of the perfect flowers with more or less distinct appendages; these usually strongly hairy outside, glabrous inside, but never with a ring of longer hairs. Tribe 3. ASTEREA.

Stigmata of the perfect flowers without appendages; or if with appendages, these hairy on both sides and with a ring of longer hairs.

Pappus never capillary; stigma rarely appendaged.

Bracts of the involucre herbaceous or foliaceous.

Receptacle with chaffy scales, subtending the flowers.

Tribe 5. HELIANTHEAE.

Receptacle naked, or in *Gaillardia* with bristles, but not chaffy-bracted.

Tribe 6. HELENIAE.

Bracts of the involucre dry and scarious.

Tribe 7. ANTHEMIDEAE.

Pappus capillary; stigma often appendaged.

Tribe 8. SENECTIONEAE.

Anther-sacs caudate at the base; heads never radiate and corollas yellow only in a few species of *Carduus*.

Anthers not appendaged at the top; heads heterogamous or dioecious; pistillate flowers with filiform corollas. Tribe 4. GNAPHALIAE.

Anther with elongated cartilaginous, mostly caudate appendages at the top; flowers all hermaphrodite or the marginal neutral; corolla not filiform.

Tribe 9. CYNAREAE.

TRIBE 1. VERNONIAE.

One genus.

1. VERNONIA.

TRIBE 2. EUPATORIAE.

Achenes 5-angled without intervening ribs; pappus of wholly capillary bristles, mostly uniserial. 2. EUPATORIUM.

Achenes 8–10-ribbed or 8–10-striate.

Bracts of the involucre herbaceous or partly colored, not striate.

5. LACINIARIA.

Bracts of the involucre not herbaceous, striate-nerved.

Pappus-bristles plumose; anthers distinct; bracts few.

3. KUHNIA.

Pappus-bristles scabrous or barbellate; anther united; bracts usually many.

4. COLEOSANTHUS.

TRIBE 3. ASTEREAE.

A. Plants not dioecious.

I. Marginal pistillate flowers, if present, ligulate.

a. Ray-flowers yellow or none.

1. Pappus consisting of scales or awns or lacking, never of numerous capillary bristles.

Heads small, not over 4 mm. high, few-flowered; pappus more or less paleaceous.

6. GUTIERREZIA.

Heads large, many-flowered; involucre in all except one species viscid; pappus of a few deciduous awns.

7. GRINDELIA.

2. Pappus at least in part of numerous capillary bristles.

a. Pappus double, the inner of capillary bristles; the outer of scales or short bristles; involucre many-flowered, hemispherical with narrow imbricated bracts.

8. CHRYSOPSIS.

b. Pappus wholly of capillary bristles.

* Heads discoid.

Involucre narrowly turbinate; its bracts more or less chartaceous, keeled, arranged in definite (usually 5) vertical ranks; achenes elongated-linear; stigma-tips subulate-filiform.

9. CHRYSOTHAMNUS.

Involucre broadly turbinate to hemispherical; its bracts more or less imbricated, but not in definite vertical ranks; achenes scarcely elongated-linear.

Stigma-tips obtuse; involucre bracts narrow, poorly imbricated. (Rayless species of) 31. ERIGERON.

Stigma-tips acute; bracts either broad or well imbricated or both. Achenes truncate at the top, gradually tapering towards the base, usually cinereous-pubescent; bracts neither broad nor abruptly acuminate.

Appendages or tips of the styles filiform; undershrubs with white-tomentulose stems and glandular-hairy foliage; leaves entire-margined.

15. MACRONEMA.

Appendages or tips of the stigmas subulate to ovate.

Leaves with spinulose-tipped teeth; corolla-tube slender. (Rayless species of) 11. SIDERANTHUS.

Leaves not spinulose, in ours entire-margined; corolla-tube dilated above.

10. ISOCOMA.

Achenes elongated, obovoid, i. e., tapering at both ends, but more so below, multi-striate, glabrous or slightly hairy; bracts of the involucre broad and abruptly acuminate; appendages of the stigmas ovate to short-subulate.

13. OONOPSIS.

* Heads radiate.

Leaves pinnately cleft or toothed; lobes or teeth spinulose-tipped.

Pappus of the fertile achenes deciduous in a ring; annuals, equally leafy throughout; bracts more or less foliaceous.

14. PRIONOPSIS.

Pappus persistent.

Bracts chartaceous, not foliaceous, merely with green tips; plants annual or perennial with a caudex, equally leafy throughout; pappus in age more or less spreading; achenes turbinate and densely silky.

11. SIDERANTHUS.

Bracts more or less foliaceous, at least above; plants perennial with taproots, large basal leaves and few and rather small

stem-leaves; pappus not spreading; achenes oblong, glabrous or sparingly pubescent. 12. PYRROCOMA.

Leaves entire or toothed, but teeth not spinulose-tipped.

Bracts not longitudinally striate.

Bracts abruptly acuminate; stems leafy up to the sessile heads. 13. OONOPSIS.

Bracts not abruptly acuminate.

Appendages of the stigma filiform, much longer than the stigmatic portion; low shrubs with whitish bark and foliaceous outer bracts. 15. MACRONEMA.

Appendages of the stigmas ovate or triangular, not longer than the stigmatic portion.

Plants low caespitose evergreen undershrubs with more or less evergreen leaves and solitary peduncled heads. 16. STENOTUS.

Plants with wholly herbaceous stem, if at all woody only at the caudex; leaves not evergreen.

Bracts, at least the outer, foliaceous or with foliaceous tips.

Disk-flowers tubular; plants with a taproot. 12. PYRROCOMA.

Disk-flowers more or less widened upwards; plants with rootstock or short caudex.

Heads corymbiform-cymose; rays small and few; plants leafy. 17. OREOCHRYSUM.

Heads solitary; rays numerous; plants dwarf. 18. TONESTUS.

Bracts of the inflorescence not at all foliaceous or merely with green tips.

Rays not more numerous than the disk-flowers; receptacle alveolate.

Inflorescence racemose or paniculate; bracts not in vertical rows. 19. SOLIDAGO.

Inflorescence corymbiform; bracts in distinct vertical rows. 20. PETRADORIA.

Rays more numerous than the disk-flowers; receptacle fimbriolate; heads corymbose.

21. EUTHAMIA.

Bracts of the involucre longitudinally striate; heads in congested corymbs. 22. OLIGONEURON.

b. Ray-flowers blue, pink or white.

1. Pappus a mere crown or of a few scales or awn-like bristles. 23. TOWNSENDIA.

2. Pappus of numerous capillary bristles.

a. Rays only slightly if at all exceeding the pappus; all annual.

Bracts in 2-3 series, the outer foliaceous; stigma-tips acute. 24. BRACHYACTIS.

Bracts in 1-2 series, narrow, not foliaceous; stigma-tips obtuse. 32. LEPTILON.

b. Rays conspicuous, longer than the pappus, usually equalling or exceeding the width of the disk.

Stigma-tips lanceolate or oblong to filiform.

Perennials with a rootstock or caudex.

Bracts acuminate, as well as the leaves tipped with callous points or spines; plants with caespitose caudices and solitary heads at the ends of the stems or branches. 25. XYLORRHIZA.

Bracts not acuminate, or if long-attenuate, with soft tips.

Pappus dilated at the apex; bracts narrow, more or less keeled. 26. UNAMIA.

Pappus not dilated at the apex.

Bracts broad with a distinct keel or mid-vein, not at all foliaceous. 27. EUCEPHALUS.

Bracts usually narrow, when broad neither keeled nor with a prominent mid-vein. 28. ASTER.

Annuals or biennials, or if short-lived perennials, not with root-stocks; bracts in many series, with herbaceous spreading or reflexed tips; stigma-tips linear to filiform. 29. MACHAERANTHERA.

Stigma-tips triangular or ovate, obtuse or rarely acutish; bracts not foliaceous.

Involucres turbinate; bracts well-imbricated in several rows. 30. LEUCELENE.

Involucres hemispherical or broader; bracts in 1-3 series. 31. ERIGERON.

II. Marginal pistillate flowers not ligulate, reduced to a filiform or narrow short tube. 33. ESCHENBACHIA.

B. Heads unisexual, dioecious, discoid; pappus of the staminate flowers with clavate tips. 34. BACCHARIS.

TRIBE 4. GNAPHALIAE.

Shrubs; bracts coriaceous; receptacle naked; pistillate flowers numerous; corolla reduced to a short slender tube; hermaphrodite flowers few and sterile; their pappus with clavate tips. 35. BERTHELOTIA.

Herbs, if at all shrubby only at the base; bracts more or less scarious.

Receptacle chaffy; stigmas of the hermaphrodite sterile flowers not truncate. 36. FILAGO.

Receptacle not chaffy; stigmas of the hermaphrodite flowers mostly truncate. Plants dioecious, or the pistillate heads with a few hermaphrodite flowers in the center.

Pappus-bristles of the pistillate flowers falling off in a ring; those of the staminate flowers clavellate or apically barbellate, crisp; central hermaphrodite flowers none. 37. ANTENNARIA.

Pappus-bristles of the pistillate flowers falling off separately; those of the staminate flowers scarcely clavellate; central hermaphrodite flowers present in the pistillate heads. 38. ANAPHALIS.

Plants not dioecious; flowers fertile throughout the heads.

39. GNAPHALIUM.

TRIBE 5. HELIANTHEAE.

A. Bracts not enclosing the achenes of the rays; plants not glandular-viscid.

I. Disk-flowers hermaphrodite but sterile.

Marginal pistillate flowers with conspicuous rays; involucre of very dissimilar sets of bracts. 40. MELAMPodium.

Marginal pistillate flowers reduced to a truncate or obliquely cleft tube; the ligule, if any, reduced to 2 or 3 small teeth. 41. PARTHENICE.

II. Disk-flowers fertile.

a. Ray-flowers fertile, with very short tube, persistent on the achenes and becoming papery in texture.

Achenes of the disk compressed; leaves entire. 42. CRASSINA.

Achenes obtusely 4-angled; leaves toothed. 43. HELIOPSIS.

b. Ray-flowers deciduous from the achenes or wanting.

1. Pappus a crown or none, or of a few scales on the angles of the achenes and rarely minute ones between.

a. Achenes of the disk-flowers not obcompressed (except in RATIBIDA); chaffs usually more or less concave and clasping.

Receptacle conic, subulate or columnar.

Achenes 4-angled. 44. BRAUNERIA.

Achenes quadrangular-compressed; apex of the achenes covered by the base of the corolla-tube. 45. GYMNOLOMIA.

Achenes nearly equally 4-angled; apex not covered by the base of the corolla. 46. RUDBECKIA.

Achenes flattened, broad-margined or winged.

47. RATIBIDA.

Receptacle from flat to convex.

Achenes of the disk neither sharp-angled, margined nor winged.

Rays fertile; their achenes commonly 3-angled or obcompressed; plants with thick balsamiferous tap-roots.

Pappus none; stem scapiform or with reduced leaves.

48. BALSAMORRHIZA.

Pappus a lacerate chaffy crown or of distinct chaffs; stem low but leafy.

49. WYETHIA.

Rays sterile or wanting; plants not with fleshy tap-root.

Pappus none or a minute ring.

45. GYMNOLOMIA.

Pappus of 2 scarious awns.

50. HELIANTHUS.

Achenes of the disk thin-edged, margined or winged.

Ray-flowers neutral; achenes scarcely winged.

51. HELIANTHELLA.

Ray-flowers fertile; achenes winged.

52. XIMENESIA.

b. Achenes obcompressed; chaffs flat or hardly concave; involucre distinctly double.

Bracts of the involucre distinct or nearly so.

Pappus in ours of small teeth, a mere border, or wanting.

53. COREOPSIS.

Pappus of 2-4 barbed or hispid awns.

54. BIDENS.

Bracts of the inner involucre united at least to near the middle.

55. THELESERMA.

2. Pappus of 5-many, linear to lanceolate scales with thickened axis and hyaline margins.

74. GAILLARDIA.

B. Bracts of the involucre uniserial, partly or wholly enclosing the achenes of the fertile ray-flowers; plants glandular-viscid.

56. MADIA.

TRIBE 6. HELENIAE.

A. Plant-tissues without oil-glands.

I. Ligules persistent and becoming papery on the striate achenes; plants more or less woolly.

57. PSILOSTROPHE.

II. Ligules deciduous or none.

a. Achenes flat with only marginal nerves; disk-corollas 4-toothed.

58. PERICOME.

b. Achenes angled, not flat, nerved or striate.

i. Receptacle naked.

a. Bracts of the involucre pale or colored, at least the margins and tips scarious.

Corollas of the disk-flowers with reflexed or spreading lobes; bracts of the broadly campanulate involucre obovate or broadly oblong.

Heads discoid.

59. HYMENOPAPPUS.

Heads radiate; ligules obscurely toothed, yellowish or white.

60. LEUCAMPYX.

Corolla of the disk-flowers with linear, erect lobes; bracts of the turbinate involucre spatulate to linear-oblancoate in two series; heads in our species radiate; ligules deeply cleft, purple.

61. POLYPTERIS.

b. Bracts of the involucre neither colored nor scarious.

Achenes 4-angled.

Foliage impressed punctate; leaves, at least the lower, opposite.

Perennials, suffruticose at the base; leaf-segments oblong to linear.

62. PICRADENIOSIS.

Annuals; leaf-segments filiform or nearly so.

63. ACHYROPAPPUS.

Foliage not impressed-punctate; leaves alternate.

Bracts obovate, cuneate or oblanceolate.

Perennials with a woody caudex; leaves entire; pappus of 10 scales.

64. PLATYSCHKUHRIA.

Annuals; leaves dissected; pappus in our species wanting.

65. BAHIA.

Bracts linear.

66. CHAENACTIS.

Achenes 5-10-ribbed.

Bracts of the involucre erect, not spreading nor reflexed.

Involucres many-flowered; pappus present; achenes tapering below.

Bracts of the involucres nearly equal and similar, all distinct.

Leaves simple; stem scapiform or with a few small leaves; heads long-peduncled.

Corollas yellow; bracts numerous; leaves linear to oblong.

67. TETRANEURIS.

Corollas flesh-colored; bracts about 12; leaf-blades from orbicular to oblong.

68. CHAMAECHAENACTIS.

Leaves dissected into linear lobes; stem low but leafy.

69. RYDBERGIA.

Bracts of the involucres unequal; the outer united at the base.

70. HYMENOXYS.

Involucres few-flowered; pappus wanting; achenes linear, 8-10-striate.

71. FLAVERIA.

Bracts of the involucres spreading or reflexed.

Leaves not decurrent on the stem; tubes of the disk-flowers moderately long.

72. DUGALDIA.

Leaves decurrent on the stem; tubes of the disk-corollas very short or reduced to a ring.

73. HELENIUM.

2. Receptacle with bristle-like chaffs.

74. GAILLARDIA.

B. Plant-tissues, especially the leaves and involucres with oil-glands; plants heavy-scented.

Bracts of the involucres more or less united; stigmas of the disk-flowers elongated.

Bracts of the involucres united only at the base; stigmas with conical tips.

75. BOEBERA.

Bracts of the involucres united into a cup; stigmas obtuse.

76. LOWELLIA.

Bracts of the involucres distinct; stigma very short, obtuse, without an appendage.

77. PECTIS.

TRIBE 7. ANTHEMIDEAE.

Receptacle chaffy.

Achenes terete, at least not flattened; involucres hemispherical, large.

78. ANTHEMIS.

Achenes flattened; involucres campanulate or obovoid, small.

79. ACHILLEA.

Receptacle naked or merely pubescent.

Heads radiate.

80. CHRYSANTHEMUM.

Heads discoid.

Plants spiny; achenes and corollas cobwebby.

81. PICROTHAMNUS.

Plants not spiny; achenes not cobwebby.

82. ARTEMISIA.

TRIBE 8. SENECTIONEAE.

Plants scapiferous, dioecious or nearly so, with large basal leaves appearing after flowering; hermaphrodite flowers usually sterile.

83. PETASITES.

Plants not scapiferous, not dioecious; disk-flowers hermaphrodite, fertile.

Involucres of many or several bracts.

Involucres of commonly much overlapping or unequal bracts.

84. HAPLOESTES.

Involucres of connivent erect herbaceous equal bracts, with or without smaller calyculate ones below.

Leaves mostly opposite; pappus of a single series of rigid bristles.

85. ARNICA.

Leaves alternate; pappus of numerous soft bristles.

86. SENECIO.

Involucres of 4-6, firm, concave, erect and strongly overlapping bracts; shrubs with alternate leaves and discoid heads.

87. TETRADYMIA.

TRIBE 9. CYNAREAE.

One genus.

88. CARDUUS.

Tribe 1. VERNONIAE.

1. VERNONIA Schreb. IRON WEED.

1. *Vernonia Jamesii* T. & G. (*V. marginata* (Torr.) Britton) On plains from Neb. and Colo. to Ark. and Tex.—“On the Arkansas.”

Tribe 2. EUPATORIAE.

2. EUPATORIUM L. JOE-PYE WEED, THOROUGH-WORT.

Leaves verticillate in whorls of threes.

Leaves ovate, acute.

Leaves lanceolate, acuminate.

Leaves opposite.

1. *E. maculatum*.2. *E. Bruneri*.3. *E. texense*.

1. *Eupatorium maculatum* L. In moist soil from N. Y. and B. C. to Ky. and N. M.—Along river east of Ft. Collins.

2. *Eupatorium Bruneri* A. Gray. (*Eupatorium Rydbergii* Britton) In moist soil from Iowa, Sask. and B. C. to Colo. and Utah.—Alt. 4000-5000 ft.—Cañon City; Ft. Collins; La Poudre near La Porte.

3. *Eupatorium texense* (T. & G.) Rydb. (*E. ageratifolium texense* T. & G.; *E. ageratifolium* A. Gray, mainly; not DC.) Rocky hills from Colo. to Tex. and Ariz.—Alt. 7000-8500 ft.—Cañon City; Box Cañon, west of Ouray; Trail Glen.

3. KUHNIA L.

Leaves oblong or lanceolate, 3-ribbed, more or less toothed.

Bracts narrowly linear, acuminate.

Bracts linear, abruptly acute.

Leaves linear, 1-ribbed, entire.

1. *K. Hitchcockii*.2. *K. glutinosa*.3. *K. Goodingii*.

1. *Kuhnia Hitchcockii* A. Nelson. Plains of Kans. and Colo.—Alt. 4000-5000 ft.—Denver.

2. *Kuhnia glutinosa* Ell. (*K. eupatorioides corymbulosa* T. & G.) On dry prairies and plains from Ills. and Mont. to Ky. and Colo.—Alt. about 5000 ft.—Boulder; New Windsor; Ft. Collins; Spring Cañon.

3. *Kuhnia Goodingii* A. Nels. On rocky hills and plains from Colo. to Tex. and Ariz.—Alt. 4000-7000 ft.—Engelmann Cañon; Granite; Manitou; Durango; Hotchkiss; Pagosa Spring.

4. COLEOSANTHUS Cass.

Leaf-blades ovate or deltoid.

Leaves slender-petioled, not spinulose-toothed; bracts thin, 2 mm. or less wide.

Heads 30-50-flowered.

Leaves thin, minutely puberulent; teeth usually broadly triangular, acute; peduncles usually longer than the heads.

Leaves thick, densely scabrous-pubescent, very veiny; teeth rounded-ovate, obtuse or mucronate; peduncles shorter than the subumbellate heads.

1. *C. grandiflorus*.2. *C. umbellatus*.

Heads 10-25-flowered.

Tips of the bracts not spreading; leaf-blades 2-4 cm. long.

3. *C. albicaulis*.

Tips of the bracts spreading, squarrose; leaf-blades less than 1 cm. long

4. *C. scaber*.

Leaves subsessile or very short-petioled, spinulose-toothed; bracts firm, 3-6 mm. wide.

6. *C. atractyloides*.

Leaves linear or oblong, sessile.

5. *C. linifolius*.

1. *Coleosanthus grandiflorus* (Hook.) Kuntze. (*Brickellia grandiflora* Nutt.) In cañons, "bad-lands" and draws from Mont. and Wash. to Colo. and Ore.—Alt. 4000-8000 ft.—Columbine; Trappers' Lake; cañon north of Palmer Lake; bank of Poudre, La Porte.

2. *Coleosanthus umbellatus* Greene. (*Brickellia grandiflora minor* A. Gray; *Coleosanthus congestus* A. Nels.) On hillsides and in cañons from Wyo. to N. M. and Ariz.—Alt. 5000-10,000 ft.—Colorado Springs; near Empire; Boulder Cañon, Boulder Co.; Pike's Peak; foot-hills, Larimer Co.; Georgetown; Trout Creek; Jefferson Co.; Golden; Cañon City; near Pagosa Peak; southeast of Ouray; Black Cañon; Idaho Springs; La Poudre; Redstone; mountains between Sunshine and Ward; Steamboat Springs; Elk Cañon; Powder River; Table Rock; Hayden; Roaring Fork, Larimer Co.

3. *Coleosanthus albicaulis* Rydb. (*Brickellia Wrightii* Gray, in part.) In cañons and on foot-hills from Colo. and Utah to N. M.—Alt. 5000-8000 ft.—Lower Boulder Cañon; Trail Glen; Manitou; Golden; Mt. Harvard; foot-hills, Larimer Co.; near Boulder; Spring Cañon; Glenwood Springs.

4. *Coleosanthus scaber* Greene. On dry soil in Colo.—Alt. about 4700 ft.—Deer River; Mesa Verde.

5. *Coleosanthus linifolius* (D. C. Eaton) Kuntze. (*Brickellia linifolia* D. C. Eaton; *C. humilis* Greene.) In arid soil from Colo. and Nev. to Calif.—Alt. 4000-7000 ft.—Arboles; Grand Junction; cañon of Smith's Fork; between Porter and Durango.

6. *Coleosanthus atractyloides* (A. Gray) Kuntze. (*Brickellia atractyloides* A. Gray.) In desert regions from Colo. and Nev. to Ariz. and Calif.—Southwestern Colo.

5. LACINIARIA Hill. BLAZING STAR.

Pappus plumose; leaves strongly punctate.

1. *L. punctata*.

Pappus merely barbellate.

Heads in a short raceme-like inflorescence; bracts obovate with dark rose-purple, lacinate apices.

2. *L. ligulistylis*.

Heads in a long raceme-like inflorescence; bracts spatulate or obovate-oblan-
ceolate with pale, merely erose apices.

3. *L. scariosa*.

1. *Laciniaria punctata* (Hook.) Kuntze. (*Liatris punctata* Hook.) On dry plains and hills from Iowa, Sask. and Mont. to Tex. and Ariz.—Alt. 4000-9000 ft.—Miller's ranch; north slope of Cheyenne Mountain; Ft. Collins; Boulder; Denver; Pike's Peak; dry plains northwest of Denver; Westcliffe; Manitou; Livermore, Larimer Co.; Cucharas Valley, near La Veta; New Windsor; Gunnison; mountains between Sunshine and Ward; Table Rock; Poudre Cañon; Ft. Collins; Golden; Colorado Springs; Salida.

2. *Laciniaria ligulistylis* A. Nels. On hills from Sask. to Colo.—Alt. 4000-8000 ft.—Head of Redstone; Table Rock; La Veta; Alamosa; Twin Lakes; Pagosa Springs; Larimer Co.; Parlin, Gunnison Co.; Westcliffe; Jack's Cabin; Trout Creek; Sugar Loaf Mountain.

3. *Laciniaria scariosa* (L.) Hill. (*Liatris scariosa* Willd.) On prairies from Me. and S. D. to Fla. and Kans. It has been reported from Colorado, but all specimens seen so named belong to the preceding.

Tribe 3. ASTEREEAE.

6. GUTIERREZIA Lag.

Disc- and ray-flowers in each head 3-7 each.

Surface of the leaves marked with large dots, each bordered by a hyaline scale.

1. *G. lepidota*.

Surface of the leaves not lepidote, either puberulent or glabrous.

Axils of the leaves with fasciculate branches.

2. *G. fasciculata*.

Axils of the leaves without fasciculate branches.

Plant shrubby.

Involucres elongated, clavate-turbinate, 2-3 mm. wide; bracts oblong or lanceolate.

3. *G. longifolia*.

Involucres campanulate, only slightly turbinate at the base, 3-4 mm. wide; bracts ovate or obovate.

4. *G. linearis*.

Plant ligneous only at the short persistent caudex.

Leaves linear, usually 1.5-4 mm. wide.

Involucres oblong-turbinate, over 5 mm. long; outer bracts lanceolate; stems 3-4 dm. high.

5. *G. scoparia*.

Involucres campanulate, somewhat turbinate only at the base; bracts ovate; stems 1-2 dm. high.

6. *G. diversifolia*.

Leaves linear-filiform, less than 1 mm. wide.

Ligules of the rays fully as long as the involucre.

7. *G. filifolia*.

Ligules of the rays about half as long as the involucre.

Heads usually peduncled and solitary at the ends of the branches.

8. *G. divaricata*.

Heads usually sessile in clusters of 3-4 at the ends of the branches.

Plant low, 1-2 dm. high; branches green; leaves 1-2 cm. long.

9. *G. juncea*.

Plants 3-4 dm. high; branches with straw-colored bark; leaves 3-4 cm. long.

10. *G. Sarothrae*.

Disc- and ray-flowers in each head only 1-2 each.

11. *G. glomerella*.

1. *Gutierrezia lepidota* Greene. On dry plains of western Colo.—Grand Junction.

2. *Gutierrezia fasciculata* Greene. On dry plains in western Colo.—Grand Junction.

3. *Gutierrezia longifolia* Greene. On dry hills and plains from Colo. and Utah to N. M.—Alt. 4000-5500 ft.—Cañon City; Westcliffe; Boulder.

4. *Gutierrezia linearis* Rydb. On plains from Neb. and Colo. to Kans. and N. M.—Alt. 6000-8000 ft.—Gunnison; Red Rock Cañon, near Pike's Peak.

5. *Gutierrezia scoparia* Rydb. On dry plains from Wyo. to Colo.—Alt. 5000-7000 ft.—Colorado Springs; Manitou; Boulder.

6. *Gutierrezia diversifolia* Greene. On plains from Sask. and Mont. to N. M. and Utah.—Alt. 5000-8000 ft.—Upper Larimer River; Ft. Collins; Gunnison; Muddy River, Middle Park; Parlin; Manitou; west of Loveland; La Veta; Timnath.

7. *Gutierrezia filifolia* Greene. On dry plains from Ida. to N. M. and Nev.—Alt. about 7000 ft.—Cucharas Valley, near La Veta.

8. *Gutierrezia divaricata* Nutt. On plains from Wyo. to Tex. and Utah.—San Juan Co.

9. *Gutierrezia juncea* Greene. On dry hills and plains from Okl. and Colo. to Ariz.—Alt. 7000-10,000 ft.—Garden of the Gods; Twin Lakes; Westcliffe.

10. *Gutierrezia Sarothrae* (Pursh.) B. & R. (*G. Euthaniae* T. & G.) On plains from Neb. and Wyo. to Kans. and Utah.—Alt. 4000-7000 ft.—Colorado Springs; Salida.

11. *Gutierrezia glomerella* Greene. On dry plains from Colo. to N. M.—Alt. about 4700 ft.—Deer Run.

7. *GRINDELIA* Willd. GUM PLANT, RESIN-WEED.

Tips of the outer bracts spreading; none reflexed. 1. *G. decumbens*.

Tips of the bracts squarrose; those of the outer ones strongly reflexed.

Heads radiate.

Pappus-awns apparently smooth; barbules seen only under a compound microscope.

Stem-leaves oval, ovate, or ovate-oblong with a broad base.

Leaves bluish-green, spinulose-dentate; heads very broad and flat; its bracts broad and even the squarrose tips flattened. 2. *G. texana*.

Leaves yellowish-green, merely dentate; heads hemispherical; its bracts narrow and with terete squarrose tips. 3. *G. squarrosa*.

Stem-leaves oblanceolate, rarely oblong.

Leaves all finely serrate, dentate or subentire.

Leaves finely and closely serrate. 4. *G. serrulata*.

Leaves rather remotely dentate or subentire. 5. *G. perennis*.

Leaves coarsely toothed; the basal ones sub-laciniate. 6. *G. subincisa*.

Pappus-bristles distinctly barbellate; barbules distinctly seen with a common pocket-lens.

Stem tall, 4-6 dm. high, usually solitary; stem-leaves broadly oblong or obovate; bracts broad, only the outer ones squarrose-reflexed.

7. *G. erecta*.

Plant low, about 3 dm. high; usually several stems from the base; stem-leaves oblanceolate or oblong; all bracts squarrose. 8. *G. subalpina*.

Heads discoid.

Stem-leaves oval or obovate. 9. *G. inornata*.

Stem-leaves oblanceolate or oblong.

Outer bracts strongly recurved; inner not squarrose. 10. *G. fastigiata*.

All bracts squarrose. 11. *G. aphanactis*.

1. *Grindelia decumbens* Greene. On plains from Kans. and Colo. to N. M.—Alt. 4000-7000 ft.—Durango; Ignacio; Pagosa Springs; Mancos; Cimarron.

2. *Grindelia texana* Scheele. (*G. grandiflora* Gray, in part; not Hook.) On plains from Colo. to Tex. and N. Mex.—Alt. about 5000 ft.—Lower Boulder Cañon.

3. *Grindelia squarrosa* (Pursh) Dunal. On prairies and plains from Iowa and Wyo. to Kans. and Ariz.—Alt. up to 6000 ft.—Colorado Springs.

4. *Grindelia serrulata* Rydb. On plains and hills from Wyo. and Colo.—Alt. about 5000 ft.—Denver; Ft. Collins.

5. *Grindelia perennis* A. Nels. On plains and hills from Sask. and Ida. to Colo.—Alt. 5000-6000 ft.—New Windsor; Boulder; Ft. Collins.

6. *Grindelia subincisa* Greene. On hills from Colo. and N. M.—Durango.

7. *Grindelia erecta* A. Nels. In the mountains of Wyo. and Colo.—Alt. 7000-10,000 ft.—Near Empire; Georgetown; Huerfano Valley, near Gardner; Cerro Summit; mountains between Sunshine and Ward.

8. *Grindelia subalpina* Greene. In the mountains from Mont. to Colo. and Utah.—Boulder; head of Lone Pine Creek.

9. *Grindelia inornata* Greene. In the mountains of Colo.—Cañon City.

10. *Grindelia fastigiata* Greene. On dry hills of western Colo.—Alt. about 4600 ft.—Grand Junction.

11. *Grindelia aphanactis* Rydb. In sandy soil in southwestern Colo.—Durango.

8. *CHRYSOPSIS* Nutt. GOLDEN ASTER.

Leaves at least when young appressed canescent.

Stem-leaves, except the lower ones sessile or nearly so.

Stem-leaves oblong to lanceolate, decidedly acute.

1. *C. hirsutissima*.

Stem-leaves obovate or obovate-lanceolate, mostly obtuse and mucronate or more seldom acutish.

Leaves usually less than 3 cm. long; those of the branches short, 1-1.5 cm. long; heads small; involucre seldom 1 cm. broad, usually subtended by leaves.

2. *C. foliosa*.

Leaves 3-6 cm. long; those of the branches not reduced; heads larger; involucre over 1 cm. broad.

Inner bracts with subulate usually brownish and spreading tips; heads sessile.

3. *C. caudata*.

Inner bracts merely acute.

Heads peduncled, naked or subtended by 1-2 small linear or oblong leaves; leaves neither cordate nor truncate at the base.

4. *C. villosa*.

Heads sessile, subtended by ample oval leaves; upper stem-leaves cordate or truncate at the base.

5. *C. amplifolia*.

Leaves all except the uppermost petioled, oblanceolate, obtuse or acutish.

Heads short-peduncled or sessile.

Stem 3-5 dm. high; heads peduncled.

6. *C. Bakeri*.

Stems low, scarcely over 1 dm. high; heads sessile.

7. *C. alpicola*.

Heads long-peduncled; peduncles 3-7 cm. long.

8. *C. pedunculata*.

Leaves hispid or hirsute with a spreading pubescence.

Leaves copiously hairy, only slightly viscid.

Leaves obovate, broadly oblanceolate or rarely oblong, subsessile except the lower; pubescence short.

9. *C. horrida*.

Leaves oblanceolate, all except the uppermost distinctly petioled.

Plant tall, 3-4 dm. high; heads more or less peduncled.

Plant densely caespitose; but stems simple to near the top.

10. *C. arida*.

Plant profusely branched.

11. *C. floribunda*.

Plant low, 1-2 dm. high; heads sessile.

12. *C. pumila*.

Leaves sparingly hairy, decidedly viscid.

Upper leaves obovate, sessile, obtuse; lower oblanceolate, petioled.

Involucre over 1 cm. broad, subtended with obovate or oblong leaves.

13. *C. resinolens*.

Involucre less than 1 cm. broad, naked or subtended by small linear leaves.

14. *C. viscida*.

Leaves all oblanceolate, acute.

15. *C. hispida*.

1. *Chrysopsis hirsutissima* Greene. In sandy soil from Sask. and N. D. to Colo. and Ariz.—Alt. 7000-9000 ft.—Arboles; Veta Pass; Mancos.

2. *Chrysopsis foliosa* Nutt. In sandy soil from Minn. and Wash. to Kans. and Colo.—Cheyenne Mountain; Red Rock Cañon; Spring Cañon; North Cheyenne Cañon.

3. *Chrysopsis caudata* Rydb. On hills and mountains of Colorado.—Alt. 5000-10,000 ft.—Ruxton Dell; near Boulder.

4. *Chrysopsis villosa* (Pursh) Nutt. (*C. imbricata* A. Nels. ?) On dry hills from Minn. and Ida. to Tex. and N. M.—Alt. 4000-10,000 ft.—Mt. Harvard; Tennessee Pass, Lake Co.; Trail Glen; Chambers' Lake; New Windsor; mountains, Larimer Co.; Pike's Peak; Clear Creek; Middle Park; Steamboat Springs.

5. *Chrysopsis amplifolia* Rydb. In the mountains of Colo.—Alt. 5000-7000 ft.—Ward; Longmont; Manitou.

6. *Chrysopsis Bakeri* Greene. (*C. incana* Greene; *C. compacta* Greene) On hills from Mont. and Ida. to N. M.—Alt. 4000-10,000 ft.—Columbine; Montrose; Jack's Cabin, Gunnison watershed; Box Cañon, west of Ouray; Redcliffe; Big Creek Gulch; Marshall Pass; Lone Pine Creek, Larimer Co.; Red Mountain road, south of Ouray; Sangre de Cristo; Deer River; Black Cañon; Cedar Edge; Rogers; near Pagosa Peak; Tennessee Pass, Lake Co.; Rist Cañon; Graymont.

7. *Chrysopsis alpicola* Rydb. On the higher peaks of Wyo. and Colo.—Alt. 11,000-13,000 ft.—Clark's Peak; South Park; Gray's Peak; Graymont.

8. *Chrysopsis pedunculata* Greene. On hills in Colo.—Pagosa Springs.

9. *Chrysopsis horrida* Rydb. On hills from Neb. and Colo. to Tex.—Alt. about 5000 ft.—New Windsor.

10. *Chrysopsis arida* A. Nels. On dry hills from Kans. and Mont. to N. M. and Ariz.—Alt. 5000-12,000 ft.—Twin Lakes; Mount Ouray; Boulder.

11. *Chrysopsis floribunda* Greene. In sandy soil in Colo.—Alt. 5000-7000 ft.—New Windsor; Black Cañon.

12. *Chrysopsis pumila* Greene. In cañons of Neb. and Colo.—Alt. 10,000-11,000 ft.—Near Empire.

13. *Chrysopsis resinolens* A. Nels. In sandy soil of Wyo. and Colo.—Alt. 5000-6000 ft.—Chambers' Lake; Boulder.

Chrysopsis resinolens obtusata A. Nels. Alt. 8000-10,000 ft.—Mountains between Sunshine and Ward.

14. *Chrysopsis viscida* (A. Gray) Greene. (*C. villosa viscida* A. Gray) In the mountains from Colo. to Tex. and Ariz.—Manitou; Breckenridge; summit of North Park Range.

15. *Chrysopsis hispida* (Hook.) Nutt. (*C. villosa hispida* A. Gray) In sandy river valleys from Sask. and Alb. to N. M. and Ariz.—Black Cañon of the Gunnison.

9. *CHRYSOTHAMNUS* Nutt. RABBIT-BRUSH.

Bracts of the involucre acuminate.

Achenes glabrous.

Leaves oblanceolate or spatulate, puberulent; plant less than 2 dm. high.

1. *C. depressus*.

Leaves narrowly linear, slightly tomentulose or glabrous.

Bracts thick, strongly carinate, glabrous.

2. *C. pulchellus*.

Bracts thin, not strongly carinate, arachnoid-ciliate.

3. *C. Bigelovii*.

Achenes pubescent.

Bracts 4-6 in each vertical row.

2. *C. pulchellus*.

Bracts 2-3 in each vertical row.

Outer bracts long-acuminate, produced and more or less foliaceous.

Leaves linear, more or less distinctly 3-nerved.

4. *C. Parryi*.

Leaves very narrowly linear, 1-nerved.

Leaves mostly erect; the upper reduced, not exceeding the heads.

5. *C. Newberryi*.

Leaves arcuate-spreading; the upper longer than the heads.

6. *C. Howardi*.

Outer bracts short, neither produced nor foliaceous.

Heads 5-8 mm. high; bracts thin, glabrous; leaves filiform.

- Leaves 2-3 cm. long, over 1 mm. wide, light green. 7. *C. Greenei*.
 Leaves 1-2 cm. long, less than 1 mm. wide, dark green. 8. *C. filifolius*.
 Heads about 1 cm. long; bracts thicker, arachnoid-ciliate.
 Leaves 1-2 cm. long; involucre lanate as well as arachnoid. 9. *C. collinus*.
 Leaves 3-4 cm. long; involucre somewhat viscid, merely arachnoid-ciliate on the margin. 10. *C. wyomingensis*.
 Bracts not acuminate.
 Achenes pubescent; bracts acute or obtuse.
 Branches at least when young more or less whitened with a pannose tomentum; style-appendages longer than the stigmatic portion; corolla 7-10 mm. long.
 Bracts and mature leaves perfectly glabrous.
 Bracts ovate, or the outer triangular; involucre about half as long as the flowers. 11. *C. virens*.
 Bracts lanceolate to linear; involucre more than half as long as the flowers.
 Lobes of the corollas lanceolate, mostly acute, in age spreading.
 Leaves nearly erect or strongly ascending, straight, 1-2 mm. wide. 12. *C. graveolens*.
 Leaves spreading or reflexed, more or less falcate, about 1 mm. wide. 13. *C. patens*.
 Lobes of the corolla ovate, obtuse, about 0.5 mm. long, erect in age. 14. *C. pinifolius*.
 Leaves about 0.5 mm. wide. 15. *C. confinis*.
 Leaves about 2 mm. wide.
 Bracts erose-ciliate on the margin, or tomentose, or both. 16. *C. plattensis*.
 Leaves 1 mm. or less, spreading.
 Leaves 1-2.5 mm. wide.
 Bracts narrow, linear-lanceolate, strongly carinate, almost glabrous, except the erose-ciliate margins. 17. *C. pulcherrimus*.
 Bracts usually broader, more or less densely tomentose and viscid as well as ciliate. 18. *C. frigidus*.
 Branches green, without tomentum; style-appendages shorter than the stigmatic portion; corolla 5-7 mm. long.
 Leaves and stem glabrous or nearly so, except the hispidulous-ciliate margins of the former.
 Leaves narrowly linear, 1-2 mm. wide, strongly twisted. 19. *C. elegans*.
 Leaves linear to lance-linear or oblanceolate, 2-8 mm. wide, not twisted.
 Bracts linear, oblong, or lanceolate.
 Bracts at least the outer ones with thick green tips. 20. *C. linifolius*.
 Bracts comparatively thin, not green-tipped. 21. *C. serrulatus*.
 Bracts ovate, oval or the inner broadly elliptic. 22. *C. latifolius*.
 Leaves and stem decidedly puberulent.
 Leaves 3-6 mm. wide, rarely twisted. 23. *C. lanceolatus*.
 Leaves 1-2.5 mm. wide, usually twisted. 24. *C. puberulus*.
 Achenes glabrous; bracts rounded at the apex. 25. *C. Vaseyi*.
1. *Chrysothamnus depressus* Nutt. (*Bigelovia depressa* A. Gray) Plains of Utah, Colo. and N. M.—Alt. 4000-8000 ft.—Gunnison; Squaw Creek, above Cimarron.
2. *Chrysothamnus pulchellus* (A. Gray) Greene. (*Bigelovia pulchella* A. Gray) On dry hills from Colo. and Utah to Tex. and N. M.; also in Mex.—Exact locality not given.

3. *Chrysanthamnus Bigelovii* (A. Gray) Greene. (*Bigelovia Bigelovii* A. Gray) On dry plains from Colo. and Utah to Tex. and N. M.—Alt. about 7000 ft.—Huerfano Co.; mesas, La Veta; Buena Vista.

4. *Chrysanthamnus Parryi* (A. Gray) Greene. (*Bigelovia Parryi* A. Gray) On hills and in dry valleys from Wyo. to Colo.—Alt. 7500–10,000 ft.—Gray's Peak; Georgetown; South Park; near Empire; Lake City; southeast of Ouray; North Fork; Pitkin; mesa, Yampa; Parlin; Cottonwood Lake; Twin Lakes; Steamboat Springs; Marshall Pass; Cerro Summit; Cumbres; Mt. Harvard; on Grizzly Creek; near Empire; Middle Park; Black Cañon of the Gunnison; Little Muddy, Gunnison Co.; Breckenridge; Hayden.

5. *Chrysanthamnus Newberryi* Rydb. On dry hills of N. M. and Colo.—Mesa Verde.

6. *Chrysanthamnus Howardi* (Parry) Greene. (*Bigelovia Howardii* A. Gray) On dry hills from Neb. and Wyo. to Colo.—Middle Park; Greene, North Park; near Walden.

7. *Chrysanthamnus Greenei* (A. Gray) Greene. (*Bigelovia Greenei* A. Gray; *C. scoparius* Rydb.) On plains of Colo.—Alt. 5000–7500 ft.—Huerfano Co.; La Veta; Hugo.

8. *Chrysanthamnus filifolius* Rydb. On plains of Colo.—Antonito; Granite.

9. *Chrysanthamnus collinus* Greene. On hills of Wyo. and Colo.—West-cliffe.

10. *Chrysanthamnus wyomingensis* A. Nelson. On dry plains of Wyo. and Colo.—South Park at Jefferson.

11. *Chrysanthamnus virens* Greene. Plains of southern Colo.—Pike's Peak; Cañon City.

12. *Chrysanthamnus graveolens* (Nutt.) Greene. (*Bigelovia graveolens* A. Gray) In cañons, on "bad-lands," and dry hills from Neb. and Mont. to N. M. and Utah.—Alt. 4000–8000 ft.—New Windsor; Golden; Grand Junction; near Denver; Grizzly Creek; Cañon City; Idaho Springs; Egeria Park; Breckenridge; Ft. Collins; Boulder; Delta; Jefferson Co.

13. *Chrysanthamnus patens* Rydb. On dry plains and hills in Colo.—Alt. 4600–7500 ft.—Grand Junction; Alamosa; Manitou; Iola.

14. *Chrysanthamnus pinifolius* Greene. On dry hills and plains in Colo.—Alt. 7000–13,000 ft.—Gunnison; Doyles; Mt. Abram.

15. *Chrysanthamnus confinis* Greene. On arid plains of Colo. and N. M.—Alt. 4000–8000 ft.—Grizzly Creek; Huerfano Valley, near Gardner.

16. *Chrysanthamnus plattensis* Greene. On plains of Wyo. and Colo.—Alt. 4000–5000 ft.—Denver; New Windsor; near Hebron; Ft. Collins.

17. *Chrysanthamnus pulcherrimus* A. Nels. On plains from Mont. to Colo.—North Park; Pagosa Springs; near Hebron; Grand River, near State Bridge; Trimble Springs; Poudre Cañon; forks of Poudre and Big South; Gypsum.

18. *Chrysanthamnus frigidus* Greene. On plains from Ass. to Colo.—Alt. 8000 ft.—Buena Vista.

19. *Chrysanthamnus elegans* Greene. On plains of Colo.—Alt. 7500–8500 ft.—Gunnison; Doyles; South Park.

20. *Chrysanthamnus linifolius* Greene. On dry plains of Wyo. and Colo.—Alt. 4000–5000 ft.—Deer Run; Grand Junction; Hotchkiss, Delta Co.; Olathe.

21. *Chrysothamnus serrulatus* (Torr.) Rydb. (*Bigelovia Douglasii serrulata* A. Gray; *C. glaucus* A. Nels.) On dry plains of Wyo. and Utah to Colo.—Alt. 5000–8000 ft.—Gypsum; road to Steamboat Springs; Cottonwood Lake; South Park, near Jefferson; North Park; headwaters of Clear Creek; Twin Lakes; Middle Park.

22. *Chrysothamnus latifolius* (D. C. Eaton) Rydb. (*Bigelovia Douglasii latifolia* A. Gray) On dry plains from Mont. and Wash. to Colo.

23. *Chrysothamnus lanceolatus* Nutt. (*Bigelovia Douglasii lanceolata* A. Gray) On dry plains and hills from Mont. and Wash. to Colo.—Alt. 7000–8500 ft.—Cottonwood Lake; Grizzly Creek; Black Cañon; Cerro Summit; North Park, near Walden; Hayden, Routt Co.

24. *Chrysothamnus puberulus* (D. C. Eaton) Greene. (*Linosyris viscidiflora puberula* D. C. Eaton) On dry plains and hills from Mont. and Wash. to Colo. and Utah.—Alt. 8000–9500 ft.—Pitkin; Parlin; South Park, south-east of Jefferson.

25. *Chrysothamnus Vaseyi* (A. Gray) Greene. (*Bigelovia Vaseyi* A. Gray) In the mountains of Wyo., Colo. and Utah.—Alt. about 7500 ft.—Middle Park; Greene, North Park; Gunnison; Squaw Hill, above Cimarron.

10. ISOCOMA Nutt.

Bracts acute, linear-lanceolate.

1. *I. pluriflora*.

Bracts obtuse or obtusish, linear, oblong or oblanceolate.

2. *I. Wrightii*.

1. *Isocoma pluriflora* (T. & G.) Greene. (*Bigelovia pluriflora* A. Gray) On plains of Colo.—“On the Arkansas.”

2. *Isocoma Wrightii* (A. Gray) Rydb. (*Bigelovia Wrightii* A. Gray) On banks and in saline soil from Colo. to Tex. and Ariz.—Alt. 4000–5000 ft.—San Juan Valley (*Brandege*).

11. SIDERANTHUS Nutt.

Leaves spinescently toothed, not pinnatifid.

Heads discoid; perennial with woody caudex.

1. *S. grindelioides*.

Heads radiate; annual.

2. *S. annuus*.

Leaves pinnatifid at least the lower ones.

Stem more or less floccose or cinereous, especially when young.

Plant cinereous-pubescent, more or less glandular.

3. *S. australis*.

Plant more or less floccose, not at all glandular.

4. *S. spinulosus*.

Plant neither floccose nor cinereous.

Plant glabrous or slightly glandular-puberulent.

5. *S. glaberrimus*.

Plant decidedly pubescent.

Plant finely puberulent.

6. *S. puberulus*.

Plant hispid-strigose.

7. *S. gracilis*.

1. *Sideranthus grindelioides* (Nutt.) Britton. (*Aplopappus Nuttallii* T. & G.) On dry plains and hills from Ass. and Nev. to Neb. and Ariz.—Alt. 4000–5500 ft.—Grand Junction; Rifle; Hotchkiss.

2. *Sideranthus annuus* Rydb. (*Aplopappus rubiginosus* A. Gray; not T. & G.) On sandy soil from Neb. and Colo. to Kans. and Tex.—Alt. 4000–5000 ft.—Platte Valley, Julesburg; New Windsor; Ft. Collins.

3. *Sideranthus australis* (Greene) Rydb. (*Aplopappus australis* Greene) On dry soil from Colo. to Tex. and N. M.; also in Mex.—Alt. about 4700 ft.—Deer Run.

4. *Sideranthus spinulosus* (Pursh) Sweet. (*Aplopappus spinulosus* DC.) On dry plains and prairies from Minn., Sask. and Mont. to Tex. and Ariz.—Alt. 4000–7000 ft.—Cheyenne Mountain; Denver; Arboles; Manitou; Ft. Collins; Cucharas Valley, near La Veta; Greeley; Cañon City; New Windsor; Spring Cañon; Hotchkiss; Boulder; roadside near Rocky Ford; Ft. Collins; Wray; Raton Range.

5. *Sideranthus glaberrimus* Rydb. On dry plains from S. D. and Wyo. to Ind. Terr. and Colo.—Table Rock.

6. *Sideranthus puberulus* Rydb. On dry hills in Colo.—Alt. up to 8000 ft.—Salida; Buena Vista.

7. *Sideranthus gracilis* (Nutt.) Rydb. (*A. gracilis* A. Gray) On dry hills from Colo. and Utah to Tex. and Ariz.; also in Mex.—Alt. about 6700 ft.—Durango; between Porter and Durango; Mancos.

12. PYRROCOMA Nutt.

Bracts except the innermost obtuse, obovate or oblong.

1. *P. crocea*.

Bracts mostly acute or acuminate.

Heads large; disk 2 cm. or more in diameter; bracts in about 3 series.

Upper part of stem and involucre decidedly villous; bracts wholly foliaceous.

2. *P. Clementis*.

Stem and involucre almost glabrous; bracts chartaceous at the base, with foliaceous tips.

3. *P. integrifolia*.

Heads smaller; disk less than 2 cm. in diameter.

Bracts in 2–3 unequal series.

Stem and bract more or less white-woolly.

4. *P. lagopus*.

Stem and bracts glabrous or nearly so.

5. *P. Vaseyi*.

Bracts nearly of the same length.

Plant villous.

6. *P. inuloides*.

Plant, except the upper parts, glabrate in age.

7. *P. uniflora*.

1. *Pyrrocoma crocea* (A. Gray) Greene. (*Aplopappus croceus* A. Gray) In the mountains from Wyo. to N. M. and Ariz.—Alt. 5000–8000 ft.—Doyle's; Cerro Summit; North Park; La Plata Cañon; Steamboat Springs; between Pallas and Sydney; Egeria Park; Little Muddy; Gunnison Co.; Walton Creek; Boulder; North Park, along the Michigan; Willow Creek, Routt Co.

2. *Pyrrocoma Clementis* Rydb. In the mountains of Wyo. and Colo.—Tennessee Pass; Robinson; Mt. Harvard.

3. *Pyrrocoma integrifolia* (Porter) Greene. (*Aplopappus integrifolius* Porter) In the mountains from Sask. and B. C. to Colo.—Rabbit-Ear Range.

4. *Pyrrocoma lagopus* Rydb. On dry plains and alkali flats in Wyo. and Colo.—North Park.

5. *Pyrrocoma Vaseyi* (Parry) Rydb. (*Aplopappus lanceolatus Vaseyi* Parry) In the mountains from Wyo. to Colo. and Utah.—Alt. up to 9000 ft.—Middle Park; Lake John, North Park; North Fork, Larimer Co.

6. *Pyrrocoma inuloides* (Hook.) Greene. (*Aplopappus inuloides* Nutt.) Plains from Mont. and Ida. to Colo.—North Park, near edge of Wyoming.

7. *Pyrrocoma uniflora* (Hook.) Greene. (*Aplopappus uniflorus* Nutt.) In river valleys from Sask. and Mont. to Colo. and Utah.

13. OONOPSIS Greene.

Dwarf; stem less than 1 dm. high; heads 6–10 dm. high.

1. *O. Engelmannii*.

Plant robust, 1.1–3 dm. high; heads 15–20 mm. high.

Heads several.

Head solitary.

2. *O. foliosa*.

3. *O. monocephala*.

1. *Oonopsis Engelmannii* (A. Gray) Greene. (*Bigelovia Engelmannii* A. Gray) On dry plains from Kans. to Colo.—Hugo Station.

2. *Oonopsis foliosa* (A. Gray) Greene. (*Aplopappus Fremontii* A. Gray) On mountains of Colo.—Alt. 5000-7000 ft.—Pueblo; Fremont Co.; Cañon City; Florence; Rocky Ford.

3. *Oonopsis monocephala* A. Nelson. Only known from the type locality at Berwind, Colorado.

14. PRIONOPSIS Nutt.

1. *Prionopsis ciliata* Nutt. (*Aplopappus ciliatus* DC.) On hillsides and banks from Mo. and Colo. to Tex.—Exact locality not given.

15. MACRONEMA Nutt.

Outer bracts oblong, acute.

Outer bracts broadly oblong, obtuse.

1. *M. discoideum*.

2. *M. obtusum*.

1. *Macronema discoideum* Nutt. (*Aplopappus Macronema* A. Gray) On the mountains from Colo. and Utah to Calif.—Alt. up to 12,000 ft.—Georgetown; Marshall Pass; Mt. Harvard; Sangre de Cristo; Mt. Ouray.

2. *Macronema obtusum* Rydb. In the mountains of Colo.—Alt. about 8000 ft.—South Cottonwood Gulch, Chaffee Co.; Twin Lakes.

16. STENOTUS Nutt.

Bracts lanceolate, acute.

Bracts oval or oblong, very obtuse.

1. *S. acaulis*.

2. *S. armerioides*.

1. *Stenotus acaulis* Nutt. (*Aplopappus acaulis* A. Gray) On hills from Sask. and Wash. to Colo. and Calif.—Meeker, Rio Blanco Co.

2. *Stenotus armerioides* Nutt. On dry hills and "bad lands" from Man. and Ass. to N. M.—Alt. up to 7000 ft.—Cimarron.

17. OREOCHRYSUM Rydb.

1. *Oreochrysum Parryi* (A. Gray) Rydb. (*Aplopappus Parryi* A. Gray; *Solidago Parryi* Greene) On mountains from Wyo. to N. M. and Ariz.—Alt. 7000-12,000 ft.—Villa Grove; Silver Plume; southeast of Ouray; Cameron Pass; Ruby; Marshall Pass; Minnehaha; Buffalo Pass, Park Range; Cottonwood Lake; Grizzly Creek; Pagosa Peak; Devil's Causeway, White River Plateau; Berthoud Pass; Georgetown; Silverton; Mt. Harvard; mountains between Sunshine and Ward; Vance Junction; Bitter Creek; Gray's Peak; Lake City; Clear Creek.

18. TONESTUS A. Nelson.

Bracts acute; plant viscid-puberulent.

Bracts obtuse; plant soft-pubescent or glabrate, scarcely viscid.

1. *T. Lyallii*.

2. *T. pygmaeus*.

1. *Tonestus Lyallii* (A. Gray) A. Nelson. (*Aplopappus Lyallii* A. Gray; *Pyrocoma Lyallii* Rydb.) On high mountains from Mont. and Wash. to Colo.—Clear Creek.

2. *Tonestus pygmaeus* (T. & G.) A. Nels. (*Aplopappus pygmaeus* A. Gray; *Macronema pygmaeum* Greene) On mountains of Wyo. and Colo.—Alt. 10,000–13,000 ft.—Clear Creek; Gray's Peak; Little Kate Mine, La Plata Mountains; Mt. Princeton; Cameron Pass, Larimer Co.; Pike's Peak; Bald Mountain; Silver Plume; Mt. Garfield; near Pagosa Peak; Beaver Creek; Raton Range; Middle Park.

19. *SOLIDAGO* L. GOLDEN ROD.

Leaves glabrous or slightly pubescent along the veins and on the margins.

Leaves not triple-veined; branches of the inflorescence not recurved-spreading; heads not secund.

Bracts of the inflorescence lanceolate or linear-lanceolate, acute or acuminate.

Leaves ciliate at the base.

I. VIRGAUREAE.

Leaves not ciliate at the base.

IV. GLABERRIMAE.

Bracts of the inflorescence oblong or linear-oblong, obtuse.

Leaves, at least the basal ones, toothed; stem-leaves few; plants 1–4 dm. high.

II. HUMILES.

Leaves all entire; stem very leafy, 4–8 dm. high.

III. SPECIOSAE.

Leaves triple-veined; heads more or less secund on recurved-spreading branches.

Plants slender, not very leafy, 2–4 dm. high; stem-leaves narrowly oblanceolate or linear.

IV. GLABERRIMAE.

Plant tall, leafy, 4–10 dm. high; stem-leaves lanceolate.

V. SEROTINAE.

Leaves densely canescent.

Leaves lanceolate; bracts narrowly linear-lanceolate.

VI. SEROTINAE.

Leaves, at least the lower ones, oblanceolate or obovate.

VII. INCANAE.

I. VIRGAUREAE.

Plant low and slender, 1–3 dm. high; inflorescence corymbiform; branches with a single or a few corymbose heads.

Heads 7–9 mm. high; inner bracts linear-lanceolate, of about the same length as the flowers and pappus; plant 2–3 dm. high.

1. *S. scopulorum*.

Heads 5–7 mm. high; bracts lanceolate; the inner shorter than the flowers and the pappus; plant usually less than 2 dm. high.

2. *S. ciliosa*.

Plants stout, 3–4 dm. high; inflorescence paniculate; branches racemiform; heads 7–9 mm. high.

Basal leaves broadly oblanceolate, acute; stem pubescent.

3. *S. rubra*.

Basal leaves narrowly oblanceolate, obtuse; stem glabrous up to the inflorescence.

4. *S. laevicaulis*.

II. HUMILES.

Plant low, 1–1.5 dm. high; inflorescence with few heads, short, congested.

5. *S. decumbens*.

Plant taller, 2–4 dm. high; inflorescence with many heads, elongated.

Leaves not ciliate; bracts oblong; inflorescence usually narrow.

6. *S. oreophila*.

Leaves ciliate at the base; bracts linear; inflorescence open.

7. *S. dilatata*.

III. SPECIOSAE.

One species.

8. *S. pallida*.

IV. GLABERRIMAE.

Heads less than 5 mm. high; stem slender.

Inflorescence decidedly viscid; leaves indistinctly triple-veined.

9. *S. viscidula*.

Inflorescence not viscid; leaves distinctly triple-veined.

Inflorescence narrow, scarcely secund; bracts linear-lanceolate.

Inflorescence usually open and more or less secund; bracts oblong-lanceolate.

Heads 6-7 mm. high; stem stout.

10. *S. missouriensis*.

11. *S. glaberrima*.

12. *S. concinna*.

V. SEROTINAE.

Leaves green, sparingly pubescent or glabrous; pubescence scabrous, mostly confined to the margins and the veins.

Stem usually glabrous up to the inflorescence; heads 5 mm. high or more; leaves glabrous except on the margins and on the mid-veins.

Stem more or less pubescent.

Heads 5 mm. or more high; leaves pubescent; plant stout.

Heads about 4 mm. high; plant comparatively slender.

Leaves pubescent at least on the veins.

Leaves glabrous, except the scabrous-ciliolate margins.

13. *S. Pitcheri*.

14. *S. polyphylla*.

15. *S. canadensis*.

16. *S. serpa*.

Leaves densely canescent, especially beneath.

Leaves usually broadly lanceolate, scabrous above.

Leaves linear-lanceolate, finely and rather softly canescent on both sides, more or less yellowish-gray.

17. *S. scabriuscula*.

18. *S. gilvocanescens*.

VII. INCANAE.

Plants low, 1-2 dm. high; inflorescence corymbiform; branches not secund.

Plants tall, 2-6 dm. high; inflorescence narrow, or if open with distinctly secund branches.

Bracts oblong of linear, obtuse; stem-leaves scarcely triple-veined; inflorescence usually narrow.

Stem-leaves oblanceolate.

Stem-leaves spatulate or elliptic.

Bracts lanceolate or ovate, acute; stem-leaves distinctly triple-veined; inflorescence usually more open.

Stem-leaves oblanceolate or elliptic; bracts lanceolate.

Stem-leaves obovate, thick; bracts ovate.

19. *S. nana*.

20. *S. pulcherrima*.

21. *S. radulina*.

22. *S. trinervata*.

23. *S. mollis*.

1. *Solidago scopulorum* (A. Gray) A. Nels. (*S. multiradiata scopulorum* A. Gray) On hills and mountains from Alb. and B. C. to Colo. and Utah.—Alt. 8000-10,000 ft.—Bard Creek, near Empire; Lake City; Grizzly Creek; White River Plateau; Robinson; Mt. Harvard; Big South; Gore Pass.

2. *Solidago ciliosa* Greene. In the higher mountains from Alb. to Colo. and Ariz.—Alt. up to 13,000 ft.—Ironton, San Juan Co.; Seven Lakes; Gray's Peak.

3. *Solidago rubra* Rydb. In the mountains of Colo.—North Park; Grizzly Creek, Larimer Co.

4. *Solidago laevicaulis* Rydb. In the mountains of Colo. and Wyo.—Alt. up to 11,000 ft.—North Park; Berthoud Pass.

5. *Solidago decumbens* Greene. (*S. humilis nana* A. Gray) On the higher mountains of Wyo. and Colo.—Alt. 10,000-13,000 ft.—Gray's Peak; near Empire; Mt. Harvard; Mt. Garfield; near Pagosa Peak; Bottomless Pit; Cameron Pass; Berthoud Pass.

6. *Solidago oreophila* Rydb. (*S. humilis* A. Gray, in part; *S. humilis Pattersonii* Gandoger) In the mountains from Mackenzie to Colo.—Alt. 7000-11,000 ft.—Clear Creek; near Empire; near Pagosa Peak; Minnehaha; Estes

Park; Grizzly Creek; Villa Grove; Bear Creek Cañon; Crystal Park; Willow Creek; La Plata Cañon; Cripple Creek road; Marshall Pass; Cottonwood Lake; Chambers' Lake; Twin Lakes; South Park; Mount Baldy; Ruxton Dell; The Crags; Steamboat Springs; Baxter's ranch; Table Rock; between Sunshine and Ward; Palmer Lake; Beaver Creek; Bosworth's ranch; Stove Prairie.

7. *Solidago dilatata* A. Nels. In the mountains of Wyo. and Colo.—Alt. 8000–9500 ft.—Mountains between Sunshine and Ward.

8. *Solidago pallida* (Porter) Rydb. (*S. spectabilis* Coulter; not A. Gray; *S. speciosa pallida* Porter) On hills from N. D. to Neb. and Colo.—Alt. 5000–6500 ft.—Lower Boulder Cañon; Manitou; Bosworth's ranch, Stove Prairie; Bergen Park.

9. *Solidago viscidula* Rydb. In the mountains of Colo.—Grand Lake.

10. *Solidago missouriensis* Nutt. (*S. Tolmieana* A. Gray) On hills and mountains from Wyo. and Ida. to Colo.—Clear Creek; North Park; Middle Park.

11. *Solidago glaberrima* Martens. (*S. Missouriensis* A. Gray; not Nutt.) On plains and hills from Mich., Alb. and Ida. to Mo., Tex. and Ariz.—Alt. 4000–9000 ft.—Pike's Peak; New Windsor; Cheyenne Mountain; Durango; near Empire; Mt. Harvard; Boulder; Ft. Collins; Long Gulch; Horsetooth Mountain; Georgetown; falls of Poudre River; Stove Prairie Hill.

12. *Solidago concinna* A. Nels. (*S. Missouriensis extraria* A. Gray) In the mountains from Alb. and B. C. to Colo.—Alt. 5000–9000 ft.—Pike's Peak; Ft. Collins; New Windsor; Gunnison; Iola; North Park; Minnehaha; Crystal Park; Ruxton Park; Durango; Dillon; Englemann Cañon; Breckenridge; Soldier Cañon.

13. *Solidago Pitcheri* Nutt. (*S. serotina* A. Gray, in part) Along streams from Minn. and Wash. to Ark. and Colo.—Alt. 4000–6000 ft.—New Windsor; Lower Boulder Cañon; La Porte, Larimer Co.; North Cheyenne Cañon; Colorado Springs; Williams' Cañon; Ft. Collins; Soldiers' Cañon; Pleasant Valley; Poudre Flats; La Porte; Denver.

14. *Solidago polyphylla* Rydb. (*S. Canadensis procera* A. Gray, in part) Along streams from B. C. to N. M. and Wash.—Alt. about 7000–8000 ft.—Englemann Cañon; Gunnison; Cañon City.

15. *Solidago canadensis* L. Among bushes from Lab. and Mackenzie to Colo.—Alt. 4000–8000 ft.—Gypsum, Eagle Co.; Parlin; Dillon; Denver; Chester; Twin Lakes; Gunnison; Gunnison Co.; North Park; Gypsum Creek Cañon; Elk River; Ft. Collins.

16. *Solidago serra* Rydb. Along streams, Wyo. and Colo.—Yampa.

17. *Solidago scabriuscula* (Porter) Rydb. (*S. Canadensis scabriuscula* Porter; var. *scabra* T. & G., in part) In dry soil from N. D. and Wyo. to Mo. and Tex.—Alt. 5000 ft.—Ft. Collins.

18. *Solidago gilvocanescens* Rydb. (*S. Canadensis gilvocanescens* Rydb.) In sandy soil from Minn. and N. D. to Neb. and Colo.—Alt. 4000–5000 ft.—Ft. Collins; Redstone.

19. *Solidago nana* Nutt. On high, dry plains from Mont. to Colo. and Ariz. Alt. up to 9000 ft.—Pagosa Springs; source of Leroux Creek.

20. *Solidago pulcherrima* A. Nels. (*S. nemoralis* A. Gray, in part; not Ait.) Dry plains from Minn. and N. D. to Colo. and Ariz.—Alt. 6000–10,000

ft.—Pike's Peak; Bosworth's ranch, Stove Prairie; mountains between Sunshine and Ward; Soldier Cañon.

A variety with linear bracts was collected in Sheep Cañon.

21. *Solidago radulina* Rydb. In the mountains of Utah and Colo.—Alt. 6000–8000 ft.—Meadow Park; Gunnison Co.

22. *Solidago trinervata* Greene. On dry plains and hills from S. D. and Wyo. to Colo. and Ariz.—Alt. 7000–9500 ft.—Lower Boulder Cañon; Idaho Springs; east of Laramie River; New Windsor; along Bear River, below Steamboat Springs; Durango; near Mancos; Iola; southeast of Ouray; Wolcott; west of Ouray; between Porter and Durango; Elk Cañon; Ft. Collins; Poudre River; Black Cañon of the Gunnison.

23. *Solidago mollis* Bartl. (*S. nemoralis incana* A. Gray) On plains from N. D. and Mont. to Colo. and Tex.—Alt. 7000–8000 ft.—Ft. Collins; New Windsor; Cucharas Valley, near La Veta.

20. PETRADORIA Greene.

1. *Petradoria pumila* (T. & G.) Greene. (*Solidago pumila* T. & G.) On high mountains from Wyo. and Nev. to Tex. and Ariz.—Alt. 5000–8000 ft.—Durango; Grand Junction; Cerro Summit.

21. EUTHAMIA Nutt.

1. *Euthamia occidentalis* Nutt. (*Solidago occidentalis* Nutt.) In moist ground from Mont. and Wash. to N. M. and Colo.—Alt. 4000–5000 ft.—Hotchkiss, Delta Co.; Sterling; Deer Run; Olathe, Delta Co.; Hotchkiss; Delta.

22. OLIGONEURON Small.

1. *Oligoneuron canescens* Rydb. (*Solidago rigida humilis* Porter) On prairies and river valleys from Sask. and Mont. to Neb. and Colo.—Pagosa Springs; Hayden.

23. TOWNSENDIA Hook.

Bracts acuminate.

Stems low with spreading basal branches, which surpass it in length.

Stems erect or nearly so, wholly simple below.

Involucre about 1.5 cm. broad, naked.

Involucre about 2–3 cm. broad, generally subtended by leaves.

1. *T. grandiflora*.

2. *T. eximia*.

3. *T. Vreelandii*.

Bracts acute or obtuse.

Stems evident, leafy.

Stems 5–20 cm. high; annuals and biennials.

Bracts of the involucre 3-ranked; pubescence of the stem appressed; leaves linear.

Bracts 2-ranked; pubescence of the stem not strictly appressed; earlier leaves spatulate.

Stem usually evident, but short, 1–5 cm. long; perennials.

Leaves more or less cinereous.

Pappus of the rays consisting of bristles $\frac{1}{4}$ – $\frac{1}{2}$ as long as those of the disk-flowers.

Pappus of the rays reduced to a crown of short squamellae.

Leaves glabrous or nearly so.

4. *T. Fendleri*.

5. *T. strigosa*.

6. *T. incana*.

7. *T. strigosa*.

7. *T. glabella*.

Plant acaulescent; heads sessile among the rosulate leaves.

Plant glabrate, cinereous only when young; leaves oblanceolate or spatulate.

Bracts broadly lanceolate, tinged with red.

Bracts obtuse; ray-flowers with a very short pappus.

8. *T. Rothrockii*.

Bracts acute; pappus of disk and ray-flowers alike.

9. *T. Wilcoxiana*.

Bracts narrowly lanceolate, mostly green.

10. *T. intermedia*.

Plant permanently cinereous; leaves linear or linear-oblanceolate.

11. *T. exscapa*.

1. *Townsendia grandiflora* Nutt. On plains and hills from S. D. and Wyo. to Ind. Terr. and Colo.—Alt. 4000–11,000 ft.—Morrison; Manitou; South Table Mountain; Ft. Collins; Larimer Co.; Red Rock Cañon; Garden of the Gods; Spring Cañon; Boulder; Horsetooth Gulch; Pennock's mountain ranch; Soldier Cañon.

2. *Townsendia eximia* A. Gray. On mountain sides from Colo. to Tex. and Ariz.—"Colorado."

3. *Townsendia Freelandii* Rydb. In mountain sides and in valleys of southern Colo.—Alt. 8000–10,000 ft.—Veta Pass; Veta Mountain; West Spanish Peak.

4. *Townsendia Fendleri* A. Gray. Gravelly hills in N. M. and Colo.—Roubadeaux Pass; Salida; Arkansas River, near Poncha Pass.

5. *Townsendia strigosa* Nutt. On gravelly hills from Wyo. to N. M. and Ariz.—Alt. 7000–10,000 ft.—Silver Plume; Mancos; Hotchkiss.

6. *Townsendia incana* Nutt. Mountains and hills from Wyo. and Utah to N. M. and Ariz.—Alt. 4000–5000 ft.—Grand Junction; Rifle; Palisades.

7. *Townsendia glabella* A. Gray. (*T. Bakeri* Greene) On dry hillsides of Colo.—Alt. about 8500 ft.—La Pagosa; Dix; Los Pinos (Bayfield).

8. *Townsendia Rothrockii* A. Gray. On mountains of southern Colo.—Alt. up to 13,000 ft.—South Park.

9. *Townsendia Wilcoxiana* Wood. On dry plains and hills from Ind. Terr. to Colo.—San Louis Range.

10. *Townsendia intermedia* Rydb. On dry plains and hills from Neb. and Wyo. to Kans. and Ariz.—Alt. about 5000 ft.—Lake City; Ft. Collins; South Park; Colorado City.

11. *Townsendia exscapa* (Richardson) Porter. (*T. sericea* Hook.) On dry plains from Sask. and Mont. to Tex. and N. M.—Alt. 4000–8000 ft.—Uncompahgre Mountains, near Los Pinos; Denver; New Windsor; Central City; butte five miles southwest of La Veta; mesas near Colorado Springs; La Veta; Ft. Collins; Los Pinos (Bayfield); plains near Denver; Dixon Cañon; hills near Arthur's Rock; Horsetooth Gulch.

24. BRACHYACTIS Ledeb.

Bracts oblong or oblong-linear, obtuse.

1. *B. frondosa*.

Bracts narrowly linear, acute.

2. *B. angusta*.

1. *Brachyactis frondosa* (Nutt.) A. Gray. (*Aster frondosus* T. & G.) Along streams and pools from Wyo. and Ida. to Colo. and Calif.—Hotchkiss, Delta Co.

2. *Brachyactis angusta* (T. & G.) Britton. (*Aster angustus* T. & G.) In wet saline soil from Ills., Sask. and Alb. to Mo., Colo. and Utah.—Blue River, above Kremmling; New Windsor; Hotchkiss.

25. **XYLORRHIZA** Nutt.

Leaves not spinulose-toothed.

Leaves spatulate, cuspidate.

Leaves linear-oblancoolate, acute.

Leaves spinulose-toothed.

Ligules 8-10 mm. long.

Ligules 15-20 mm. long.

1. *X. venusta*.

2. *X. villosa*.

3. *X. coloradensis*.

4. *X. Brandegei*.

1. *Xylorrhiza venusta* (Jones) Heller. (*Aster venustus* Jones) In dry places in Colo. and Utah.—Alt. about 7000 ft.—Cimarron; Hotchkiss.

2. *Xylorrhiza villosa* Nutt. (*Aster Xylorrhiza* T. & G.) In rocky places and clayey soil in Wyo. and Colo.—North of Craig, Routt Co.

3. *Xylorrhiza coloradensis* (A. Gray) Rydb. (*Aster coloradensis* A. Gray) In the higher mountains of Colo.—South Park.

4. *Xylorrhiza Brandegei* Rydb. On high peaks in southern Colo.—Alt. 12,000 ft.—San Juan Pass.

26. **UNAMIA** Greene.

1. *Unamia ptarmicoides* (Nees) Greene. (*Aster ptarmicoides* T. & G.) On rocky banks and bluffs from Mass. and Sask. to N. Y. and Colo.—Alt. 4000-7000 ft.—Cañon on east side of Cheyenne Mountain; Horsetooth Mountains; Soldier Cañon; Table Rock.

27. **EUCEPHALUS** Nutt.

Bracts all thin and acute, villous-ciliate on the margins; style-appendages subulate.

1. *E. Engelmannii*.

Bracts firmer, merely ciliolate; the outer obtuse; style-appendages obtuse.

Inner bracts acute.

2. *E. glaucus*.

All bracts obtuse or mucronate.

3. *E. formosus*.

1. *Eucephalus Engelmannii* (A. Gray) Greene. (*Aster Engelmannii* A. Gray) In the mountains from Mont. and B. C. to Colo. and Wash.—Alt. 6000-10,000 ft.—Sierra Madre; Steamboat Springs; Crested Butte; Four-mile Hill, Routt Co.; between Pallas and Sydney; MacIntyre Creek, Larimer Co.; Ruby; Fish Creek Falls; summit of North Park Range, Routt Co.

2. *Eucephalus glaucus* Nutt. (*Aster glaucus* T. & G.) In the mountains of Wyo., Colo. and Utah.—Alt. 7000-10,000 ft.—Headwaters of Clear Creek; Gray's Peak; Bosworth's ranch; Black Cañon; Durango; chaparral-covered hills southeast of Ouray; about Ouray; Grand Lake; Home; Pagosa Springs; mountains between Sunshine and Ward; Roaring Fork, Larimer Co.

3. *Eucephalus formosus* Greene. In the mountains of Colo.—Alt. about 9500 ft.—Near Pagosa Peak.

28. **ASTER** L.

Involucres and peduncles glandular.

Bracts narrowly linear, almost equal in length.

I. CAMPESTRES.

Bracts thick, oblanceolate, well imbricated.

II. OBLONGIFOLII.

Involucres and peduncles not glandular.

Outer bracts neither foliaceous nor equalling or surpassing the inner.

Bracts more or less pubescent on the back.

Bracts not bristle-pointed.

Heads solitary; plant less than 3 dm. high; leaves oblanceolate or the upper linear.

III. ALPINI.

Heads corymbose or paniculate.

Plants less than 1 dm. high, glabrous up to the villous inflorescence.

IV. ANDINI.

Plants 2-6 dm. high; pubescence of the stem and leaves hirsute or strigose, usually scant.

V. GRISEI.

Bracts bristle-pointed.

VI. MULTIFLORI.

Bracts glabrous, except the ciliate margins.

Bracts linear, oblong or lanceolate, all acute or acutish.

Lower leaves long-petioled; blades cordate or ovate (rarely broadly lanceolate), usually more or less serrate.

VII. SAGITTIFOLII.

Lower leaves oblanceolate, linear, or lanceolate.

Plants perfectly glabrous throughout.

Bracts whitish-coriaceous below and with a distinctly rhombic green tip above; upper leaves auriculate-clasping.

VIII. LAEVES.

Bracts linear-subulate, green throughout; leaves narrowly linear, not clasping.

IX. PORTERIANI.

Upper part of the stem and peduncles with at least pubescent lines.

Heads usually numerous in a leafy panicle or compound corymb.

Stem only with pubescent lines.

Bracts narrowly oblanceolate with rhombic tips; leaves thickish, the lower often triple-nerved.

X. SUBRACEMOSI.

Bracts linear to subulate with narrow linear-oblanceolate green backs or the outer wholly green; leaves thin, never triple-nerved.

XI. SALICIFOLII.

Stem at least above pubescent on all sides.

XII. LONCHOPHYLLI.

Heads few in a naked small corymb.

XIII. OCCIDENTALES.

Bracts oblanceolate, the outer obtuse.

XIV. ASCENDENTES.

Outer bracts foliaceous, equalling or surpassing the inner.

Heads rather numerous in an open leafy panicle.

XV. FULCRATI.

Heads few, in a usually simple, racemose or corymbose inflorescence with nearly erect branches.

XVI. FOLIACEI.

I. CAMPESTRES.

Leaves oblong to linear-lanceolate.

1. *A. Novae-Angliae*.

Leaves linear.

2. *A. campestris*.

II. OBLONGIFOLII.

Leaves oblong or lanceolate.

Leaves scabrous-hirsutulous, mostly spreading or reflexed.

3. *A. Kumleinii*.

Leaves glabrous, except the bristly-ciliate margins, ascending.

4. *A. Fendleri*.

Leaves linear or the lower ones oblanceolate.

5. *A. pauciflorus*.

III. ALPINI.

One species.

6. *A. alpinus*.

IV. ANDINI.

One species.

7. *A. andinus*.

V. GRISEI.

Leaves rather copiously and permanently appressed-hirsutulous.

Plant 3-4 dm. high; stem retrorse-hirsute below.

8. *A. griseus*.

Plant 1-1.5 dm. high; hairs of the stem not retrorse.

9. *A. griseolus*.

Leaves sparingly strigose and glabrate in age, or perfectly glabrous, except the hispidulous-ciliate margins.

Bracts with green tips and mid-veins.

Stem stout; leaves oblanceolate.

10. *A. Underwoodii*.

Stem slender; leaves narrowly linear-oblanceolate or linear.

Leaves firm; bracts with thick tips.

11. *A. vallicola*.

Leaves and bracts thin.

12. *A. Nelsonii*.

Outer bracts green almost throughout.

13. *A. violaceus*.

VI. MULTIFLORI.

Pubescence of the stem spreading or reflexed.

Heads less than 5 mm. high.

14. *A. exiguus*.

Heads 6-8 mm. high.

15. *A. crassulus*.

Pubescence of the stem appressed or ascending.

Bracts very unequal in length, well imbricated, the outer much shorter.

Bracts narrowly oblanceolate, acutish, especially the inner.

16. *A. multiflorus*.

Bracts broadly oblanceolate or the outer spatulate, very obtuse.

17. *A. polycephalus*.

Bracts almost equal in length or the outer sometimes longer; heads few or solitary at the ends of the branches.

Bracts thick, very squarrose; leaves thick, densely strigose.

18. *A. commutatus*.

Bracts thin, not squarrose; leaves sparingly strigose, in age often glabrate.

19. *A. falcatus*.

VII. SAGITTIFOLII.

One species.

20. *A. Lindleyanus*.

VIII. LAEVES.

Green tips of the bracts broadly rhombic; leaves of the branches much reduced.

21. *A. laevis*.

Green tips of the bracts narrowly rhombic or rhombic-oblanceolate; leaves of the branches gradually but not conspicuously reduced.

22. *A. Geyeri*.

IX. PORTERIANI.

One species.

23. *A. Porteri*.

X. SUBRACEMOSI.

Inflorescence falsely racemose; leaves linear to oblanceolate.

24. *A. subracemosus*.

XI. SALICIFOLII.

Inflorescence elongated, not flat-topped.

Heads numerous in a much branched panicle; bracts not with white mid-ribs.

Leaves distinctly toothed.

Disk of the head about 1 cm. high and broad; leaves thickish.

25. *A. salicifolius*.

Disk 6-8 mm. high and broad; leaves thin.

26. *A. paniculatus*.

Leaves entire, rarely denticulate.

All bracts narrowly linear; branches ascending; rays purplish.

Bracts almost linear-filiform, more or less squarrous.

27. *A. hesperius*.

Bracts linear, erect.

28. *A. coerulescens*.

Outer bracts broader than the inner, oblanceolate; branches more divergent.

Rays usually white.

29. *A. Osterhoutii*.

Rays purple.

30. *A. fluviatilis*.

Heads fewer; bracts with white mid-ribs.

31. *A. laetevirens*.

Inflorescence more or less flat-topped.

Leaves lanceolate to linear-lanceolate, firm; heads numerous.

32. *A. corymbiformis*.

Leaves narrowly linear, thin; heads few.

33. *A. longulus*.

XII. LONCHOPHYLLI.

One species.

34. *A. lonchophyllus*.

XIII. OCCIDENTALES.

One species.

35. *A. Fremontii*.

XIV. ADSCENDENTES.

Heads few in a simple corymb, less than 1 cm. high; upper leaves much reduced; stem 2-3 dm. high, slender. 36. *A. armeriaefolius*.

Heads many in a leafy panicle.

Heads about 1 cm. high; stem-leaves thick, lanceolate or oblanceolate.

37. *A. Tweedyi*.

Heads less than 1 cm. high; stem-leaves linear or narrowly linear-oblanceolate.

Lower leaves oblanceolate; bracts glabrous, except the ciliate margins; plant 1-3 dm. high. 38. *A. adscendens*.

Lower leaves narrowly linear-oblanceolate.

Plant low, 2-3 dm. high, with a ligneous caudex; bracts usually hairy on the back. 11. *A. vallicola*.

Plant 3-6 dm. high, from a more or less branched rootstock.

Bracts more or less hairy on the back. 12. *A. Nelsonii*.

Bracts glabrous except the ciliate margins. 39. *A. Nuttallii*.

XV. FULCRATI.

Outer bracts much exceeding the disk; some twice as long.

40. *A. fulcratus*.

Outer bracts seldom exceeding the disk.

41. *A. Eatonii*.

XVI. FOLIOSI.

Plant tall, 4-8 dm. high.

Bracts mainly linear or linear-lanceolate.

42. *A. frondens*.

Outer bracts broadly lanceolate or oblanceolate.

Outer bracts mostly acute.

43. *A. Canbyi*.

Outer bracts mostly obtuse.

44. *A. Burkei*.

Plant low, 1-2 dm. high.

45. *A. apricus*.

1. *Aster Novae-Angliae* L. Low ground from Canada to S. C., Colo. and Sask.—Cañon City.

2. *Aster campestris* Nutt. In valleys from Mont. and Wash. to Colo. and Ore.—Alt. up to 9000 ft.—Breckenridge; Dillon; Manitou; Laramie River, Larimer Co.

3. *Aster Kumleini* Fries. (*A. oblongifolius rigidulus* A. Gray) On dry plains and prairies from Minn. to S. D.—Alt. 4000-7000 ft.—Near Bent's Fort; Cucharas Valley, near La Veta.

4. *Aster Fendleri* A. Gray. On plains and sandhills from Kans. and Colo. to N. M.—Alt. up to 7000 ft.—Arkansas River, above Cañon City.

5. *Aster pauciflorus* Nutt. Wet saline soil from Sask. to S. D., N. M. and Ariz.—Warm soda springs in Animas Valley.

6. *Aster alpinus* L. In arctic and alpine places from Mackenzie and Alaska to Colo.—Alt. 12,000 ft.—Berthoud Pass.

7. *Aster andinus* Nutt. On alpine peaks from Mont. to Colo.—Gray's Peak; Mt. Harvard.

8. *Aster griseus* Greene. In the mountains of Colo.—Alt. about 8000 ft.—Doyles.

9. *Aster griseolus* Rydb. On the higher mountains of Colo.—Mt. Harvard; Twin Lakes; Breckenridge.

10. *Aster Underwoodii* Rydb. On high mountains of Colo. and Wyo.—Alt. 8000-10,000 ft.—Ironton Park, nine miles south of Ouray; Eldora and Baltimore.

11. *Aster vallicola* Greene. In the mountains from Wyo. and Nev. to Colo.—Alt. 7000-8500 ft.—Alamosa; Sargent; Pagosa Springs; southeast of Ouray.

12. *Aster Nelsonii* Greene. In the mountains of Colo. and Wyo.—Alt. 7000-8000 ft.—Iola; Buena Vista.

13. *Aster violaceus* Greene. In the mountains of Colo.—Mt. Harvard.
14. *Aster exiguus* (Fern.) Rydb. (*A. ciliatus* Muhl.) On prairies and plains from Vt. and Wash. to Pa. and Ariz.; also in Mex.—Ft. Collins; Olathe; Gypsum; Sunset Cañon.
15. *Aster crassulus* Rydb. On plains from N. D. and Ida. to Colo. and Calif. (?)—Alt. 4000-8000 ft.—Near Denver, Platte River; La Veta; Gunnison; Parlin, Gunnison Co.; Seldon; along Bear River, below Steamboat Springs; Pagosa Springs; Gypsum; Ft. Collins; Hotchkiss.
16. *Aster multiflorus* Ait. On prairies and sterile ground from Me. and Mont. to Ga. and Mex.—Alt. 4000-5000 ft.—Near Bent's Fort; Ft. Collins.
17. *Aster polycephalus* Rydb. (*A. scoparius* D. C.; not Nees) On plains and hills from Alb. and Neb. to Tex. and Ariz.—Alt. 4000-7000 ft.—Colorado Springs; McCoy; Twin Lakes; Ft. Collins; Trail Glen; Westcliffe; Salida; Olathe; Poudre River; Baxter's ranch; Poudre Cañon.
18. *Aster commutatus* A. Gray. On plains and river banks from Minn. to Wyo., to Kans. and Nev.—Alt. 4000-7000 ft.—Colorado Springs; Gunnison; Westcliffe.
19. *Aster falcatus* Lindl. In valleys from Mackenzie and Alaska to Colo.—Alt. about 8000 ft.—Doyles; Gunnison Co.; near Colorado City.
20. *Aster Lindleyanus* T. & G. In valleys from Lab. and B. C. to N. H. and Colo.—Poudre near La Porte.
21. *Aster laevis* L. In open woodlands from Ont. and Sask. to La. and N. M.—Westcliffe; Tobe Miller's ranch; Poudre River; Ft. Collins; Ruxton Dell.
22. *Aster Geyeri* (A. Gray) Howell. (*A. laevis Geyeri* A. Gray) Valleys from Alb. and Wash. to Colo.—Alt. 6000-8000 ft.—Cheyenne Mountain; North Cheyenne Cañon; Parlin, Gunnison Co.; mountains, Larimer Co.; near Pagosa Peak; Engelmann Cañon; Box Cañon, west of Ouray; Ft. Collins; Redstone; Poudre River; Bosworth's ranch; Palmer Lake.
23. *Aster Porteri* A. Gray. In the mountains of Colo.—Alt. 5000-10,000 ft.—Golden; Lower Boulder Cañon; Minnehaha; Idaho Springs; North Cheyenne Cañon; Ft. Collins; Bosworth's ranch; Cheyenne Mountain; between Sunshine and Ward; cañon west of Palmer Lake.
24. *Aster subracemosus* Rydb. In valleys from Mont. and Colo.—Alt. 7500-8500 ft.—Southeast of Ouray; North Park.
25. *Aster salicifolius* Lam. On wooded banks from Me. and Ass. to Fla., Tex. and Colo.—New Windsor; North Park; Ft. Collins.
26. *Aster paniculatus* Lam. On wooded banks from N. B. and N. D. to Va., Kans. and Colo.—Gypsum.
27. *Aster hesperius* A. Gray. Along streams from Colo. to N. M. and Calif.—New Windsor.
28. *Aster coerulescens* DC. (*A. salicifolius coerulescens* A. Gray) On rocky banks from Wyo. to Tex. and Colo.—New Windsor; Ft. Collins; Olathe, Montrose Co.; Gypsum; Poudre River; Home.
29. *Aster Osterhoutii* Rydb. Along ditches in northern Colo.—New Windsor.
30. *Aster fluviatilis* Osterhout. Along streams in Colo.—New Windsor.
31. *Aster laetevirens* Greene. Along streams in Colo. and Wyo.—Home; Dale Creek, Larimer Co.

32. *Aster corymbiformis* Rydb. In meadows in Colo.—Alt. 5000-8000 ft.—Parlin, Gunnison Co.; Ft. Collins; Westcliffe; Denver.

33. *Aster longulus* Sheldon. In wet meadows from Minn. and Alb. to Neb. and Colo.—Twin Lakes; Westcliffe.

34. *Aster lonchophyllus* Greene. In the mountains of Colo.—Alt. 8000-10,000 ft.—Crested Butte; Gore Pass.

35. *Aster Fremontii* A. Gray. In valleys from Mont. to Colo.—Alt. 9000-12,000 ft.—Cameron Pass; Breckenridge; Michigan; Trappers' Lake; Iron-ton Park, nine miles south of Ouray; Sherwood's; Laramie River; Robinson; Twin Lakes; Marshall Pass; Ruxton Park; Lake City.

36. *Aster armeriaefolius* Greene. In the mountains of Wyo. and Colo.—Alt. 8000-10,000 ft.—Doyles; Marshall Pass; Laramie River, Larimer Co.; Grizzly Creek; Bosworth's ranch, Stove Prairie.

37. *Aster Tweedyi* Rydb. In valleys of Wyo. and Colo.—Alt. about 5000 ft.—Near Laramie River, Larimer Co.

38. *Aster adscendens* Lindl. In valleys from Ass. to Colo. and Nev.—Alt. 8000-10,000 ft.—Near Empire; mountains between Sunshine and Ward; Ft. Collins; Grizzly Creek.

39. *Aster Nuttallii* T. & G. (*A. orthophyllus* Greene) In the mountains from Wyo. to Colo. and Calif.—Alt. 5000-8000 ft.—Gunnison; Ft. Collins; Cerro Summit; Montrose.

40. *Aster fulcratus* Greene. In valleys of Colo.—Alt. about 9000 ft.—Near Pagosa Peak.

41. *Aster Eatonii* (A. Gray) Howell. (*A. foliaceus Eatonii* A. Gray; *Brachyactis hybrida* Greene) In the mountains from Mont. and B. C. to Colo. and Calif.—Alt. about 5000-8000 ft.—Poudre River; Gunnison; Upper Arkansas; Cheyenne Cañon.

42. *Aster frondeus* (A. Gray) Greene. (*A. foliaceus frondeus* A. Gray; *Aster glastifolius* Greene) In the mountains from Ida. and B. C. to Colo. and Nev.—Alt. 8000-10,000 ft.—Empire; near Laramie River, Larimer Co.; Ruxton Dell; near Pagosa Peak; Mt. Harvard.

43. *Aster Canbyi* Vasey. In the mountains of Colo.—Alt. 8000-11,000 ft.—Crested Butte; McCoy; near Grand Lake; Mt. Harvard; mountains between Laramie River and North Park; Gypsum; Berthoud Pass; cañon west of Palmer Lake.

44. *Aster Burkei* (A. Gray) Howell. (*A. foliaceus Burkei* A. Gray) In the mountains from Wyo. and Wash. to Colo. and Ariz.—Robinson; Steamboat Springs; Hotchkiss.

45. *Aster apricus* (A. Gray) Rydb. (*A. foliaceus apricus* A. Gray) On alpine peaks from Mont. and B. C. to Colo. and Ore.—Alt. 8000-12,000 ft.—Gray's Peak; Twin Lakes; Westcliffe; Boreas; Buffalo Pass; Empire; Berthoud Pass; Grizzly Creek.

29. *MACHAERANTHERA* Nees.

Leaves twice pinnatifid; root annual; achenes terete.

1. *M. tanacetifolia*.

Leaves spinulose-toothed; plant perennial or biennial; achenes compressed.

Bracts linear-subulate; green tips of most of them longer than the straw-colored lower portion, squarrose-reflexed.

Stem and inflorescence distinctly viscid.

Stem-leaves lanceolate or oblong, usually distinctly triple-veined.

Leaves thin, coarsely but not saliently toothed; bracts over 1 mm. wide.

2. *M. Bigelovii*.

Leaves thick with salient teeth; plant very glandular; bracts less than 1 mm. wide.

Achenes glabrous or minutely pubescent; stem glabrous below.

3. *M. varians*.

Achenes strigose; stem glandular hispid throughout.

4. *M. aspera*.

Stem-leaves linear or oblanceolate, 1-veined.

Plant 2-5 dm. high; heads numerous or several in a panicle or raceme.

Basal leaves spatulate, coarsely but not saliently toothed or entire; inflorescence divaricate.

5. *M. viscosa*.

Basal leaves narrowly oblanceolate, saliently toothed; inflorescence narrow; plant about 2 dm. high.

6. *M. viscosula*.

Plant 1-2 (seldom 3) dm. high; heads solitary or few; basal leaves broadly spatulate, toothed.

7. *M. Pattersonii*.

Stem strigose-puberulent; involucre slightly if at all viscid.

8. *M. rubricaulis*.

Bracts linear with lanceolate or rhombic green tips, which are usually much shorter than the straw-colored lower portion.

Leaves cinereous.

Bracts canescent, scarcely at all viscid or glandular.

9. *M. canescens*.

Bracts densely viscid or glandular, especially the tips.

10. *M. pulverulenta*.

Leaves glabrous, or glandular-hispid or scabrous, not cinereous.

Stem puberulent or glabrate, glandular only on the inflorescence.

Bracts slightly if at all squarrose.

Stem slender with strongly ascending branches; leaves subentire.

11. *M. glabella*.

Stem divaricately branched; lower leaves sharply toothed.

12. *M. ramosa*.

Bracts strongly reflexed-squarrose.

Leaves all, except those of the smaller branches, toothed.

13. *M. Selbyi*.

Leaves all entire.

14. *M. spectabilis*.

Stem densely glandular-hispid.

Bracts more or less glandular-pubescent and with squarrose tips.

15. *M. cichoriacea*.

Bracts grayish puberulent; tips not squarrose.

16. *M. Fremontii*.

1. *Machaeranthera tanacetifolia* (H. B. K.) Nees. (*Aster tanacetifolius* H. B. K.) In moist sandy soil from S. D. and Mont. to Tex. and Ariz.—Denver; Wyoming line; foothills, west of Ft. Collins; New Windsor; Pueblo; Rocky Ford; Spring Cañon.

2. *Machaeranthera Bigelovii* (A. Gray) Greene. (*Aster Bigelovii* A. Gray) On plains and foot-hills of Colo. and N. Mex.—Alt. 5000-6000 ft.—Boulder.

3. *Machaeranthera varians* Greene. On plains and mountains of Colo. and N. M.—Alt. 6000-8000 ft.—Hinsdale Co.; Colorado Springs; near Pagosa Peak; Bottomless Pit, Pike's Peak.

4. *Machaeranthera aspera* Greene. On the mountains of Colo.—Alt. 8000-10,000 ft.—Manitou; Ute Pass; Hinsdale Co.; Colorado Springs; Pike's Peak; Engelmann Cañon; Como; Georgetown; mountains between Sunshine and Ward.

5. *Machaeranthera viscosa* (Nutt.) Greene. (*Aster canescens viscosus* A. Gray) On dry hills and plains from Wyo. to Colo. and Calif. (?)—Alt. 6000-10,000 ft.—Colorado Springs; Sangre de Cristo Creek; Rogers; Grecian Bend, Pike's Peak; Trail Glen; Twin Lakes; Mt. Harvard; Table Rock.

6. *Machaeranthera viscosula* Rydb. On plains and mountains of Colo.—Veta Pass; South Park; southeast of Jefferson.

7. *Machaeranthera Pattersonii* (A. Gray) Greene. (*Aster Pattersonii* A. Gray) In moist places in the mountains of Colo.—Alt. 10,000–14,000 ft.—Caribou; Gray's Peak and vicinity; Silver Plume; Berthoud Pass.

8. *Machaeranthera rubricaulis* Rydb. On plains, table lands and hills of Colo.—Alt. 5000–7000 ft.—Platte River; Denver; Colorado Springs; La Veta; mountain above Andrews' ranch; south of Antonito.

9. *Machaeranthera canescens* (Pursh) A. Gray. (*Aster canescens* Pursh) On sterile ground and sandy banks from Sask. and B. C. to Colo.—North Park; Honnold.

10. *Machaeranthera pulverulenta* (Nutt.) Greene. On dry plains from Mont. to Colo.—Gypsum; North Fork, Larimer Co.

11. *Machaeranthera glabella* Greene. In the mountains of Colo.—Alt. 7000–10,000 ft.—Black Cañon; Gunnison; southeast of Ouray; White River Plateau; Parlin; Cerro Summit.

12. *Machaeranthera ramosa* A. Nels. In the mountains of Wyo. and Colo.—Alt. 8000–9500 ft.—Pitkin; Grizzly Creek; Gypsum.

13. *Machaeranthera Selbyi* Rydb. In cañons and meadows in Colo.—Alt. 7500–9500 ft.—West of Ouray; Mt. Harvard.

14. *Machaeranthera spectabilis* Greene. In the mountains of Colo.—Alt. up to 10,000 ft.—Marshall Pass; Gypsum.

15. *Machaeranthera cichoriacea* Greene. On hills and mountains from Wyo. to N. M.—Alt. 4500–7500 ft.—Trail Glen; Westcliffe; Ft. Collins; Twin Lakes; Deer Run.

16. *Machaeranthera Fremontii* Rydb. In black soil of river bottoms, Colo.—“Platte Waters.”

30. *LEUCELENE* Greene.

Upper leaves strigose, slightly glandular and not conspicuously hispid-ciliate.

Lower leaves broadly spatulate; upper linear-subulate; branches long and slender.

Leaves all linear-spatulate; branches short.

1. *L. arenosa*.

2. *L. serotina*.

Upper leaves conspicuously hispid-ciliate, copiously glandular.

Upper leaves linear-oblongate; the lower spatulate.

3. *L. hirtella*.

Upper leaves linear-subulate; the lower linear or linear-oblongate.

Leaves of the branches 6–12 mm. long.

4. *L. alsinoides*.

Leaves of the branches 2–5 mm. long.

5. *L. ericoides*.

1. *Leucelene arenosa* Heller. (*Aster ericaefolius tenuis* A. Gray) On dry hills from Colo. to Tex. and Ariz.; also Mex.—Alt. 4000–7000 ft.—Cimarron; Hotchkiss.

2. *Leucelene serotina* (Greene) Rydb. On arid hills from Colo. and Utah to Tex. and Ariz.—Cañon City.

3. *Leucelene hirtella* (A. Gray) Rydb. (*Aster ericaefolius hirtella* A. Gray) On dry hills from Wyo. and Utah to Tex. and Ariz.—Arboles; Leroux Creek; mountain above Manitou; Palisades; Grand Junction.

4. *Leucelene alsinoides* Greene. On dry hills from Colo. to Tex. and N. M.—Alt. up to 8000 ft.—Salida; Rocky Ford, Otero Co.; Walsenburg.

5. *Leucelene ericoides* (Torr.) Greene. (*Aster ericaefolius* Rothr.) On dry hills from Colo. to Tex. and N. M.—“Colorado” (James).

31. **ERIGERON L. FLEABANE.**

Bracts of the involucre in 1-2 series of almost equal length, not thickened on the back.

Rays inconspicuous, erect or ascending, usually involute and incurved, numerous; often inside them a series of rayless pistillate flowers; leaves entire.

I. ACRES.

Rays conspicuous, spreading, flat; no rayless pistillate flowers inside.

Plant without runners.

Perennials.

Leaves dissected or deeply cleft.

II. MULTIFIDI.

Leaves entire or merely toothed.

Stems low, less than 2 dm. high, scapiform, usually bearing only one head; stem-leaves usually reduced.

Involucres and peduncles villous with many-celled hairs; bracts comparatively broad.

III. UNIFLORI.

Involucres and peduncles hirsute to glandular-puberulent or glabrate, not long-villous.

IV. RADICATI.

Stem leafy, 2-10 dm. high, if lower bearing several heads; stem-leaves ample.

Stems densely caespitose from a thick tap-root; heads small; disk rarely over 1 cm. wide.

Pappus double; stem hirsute.

V. PUMILI.

Pappus simple; stems strigose.

VI. DECUMBENTES.

Stems usually solitary from the ends of distinct (sometimes branched) rootstocks; heads large; disk over 1 cm. wide.

Bracts loose with reflexed tips; rays broad; pappus simple; lower leaves broadly oblanceolate, the upper often reduced.

Bracts villous.

VII. ELATIORES.

Bracts glandular-puberulent or glabrous.

VIII. SALSUGINOSI.

Bracts appressed, except the very tips; rays narrow; pappus double.

Upper stem-leaves ample, ovate to lanceolate, not much smaller than the lower, which are more or less distinctly 3-nerved; peduncles usually short, ascending.

IX. MACRANTHI.

Upper stem-leaves reduced, linear-lanceolate; none of the leaves 3-nerved; peduncles long and erect.

X. GLABELLI.

Annuals or biennials.

Stem-leaves not cordate-clasping.

Stems rather simple with a few large heads; disks about 1 cm. or more broad.

X. GLABELLI.

Stems much branched, leafy, with numerous small heads; disk 6-9 mm. broad.

Stems strigose, except at the base; pappus-bristles of the rays usually lacking.

XI. RAMOSI.

Stems and leaves densely short-pubescent with spreading hairs; pappus-bristles of the rays present.

Annuals; pappus scant and simple.

XIII. BELLIDIASTRA.

Biennials (rarely perennials); pappus double, the outer of short subulate squamellae.

XIV. DIVERGENTES.

Stem-leaves broad, cordate-clasping.

XII. PHILADELPHICI.

Plants first with a scapiform, naked peduncle, later producing lateral runner-like branches.

XV. FLAGELLARES.

Bracts of the involucre in 3-4 series, more or less imbricated, thickened on the back; the outer usually successively shorter.

Achenes terete or nearly so, several-nerved.

XVI. CANI.

Achenes flattened or quadrangular, 2-4-nerved.

XVII. CAESPITOSI.

I. ACRES.

Bracts of the involucre linear, abruptly acute, never glandular; inflorescence racemiform with almost erect branches.

Low, 1-2 dm. high; stem-leaves sessile; peduncles short.

Taller, 3-6 dm. high, lower stem-leaves petioled; basal leaves oblanceolate; peduncles elongated.

Bracts of the inflorescence linear-subulate, long-attenuate, and more or less glandular-puberulent; inflorescence inclined to be corymbiform or paniculate; branches ascending.

Bracts glandular-puberulent, rarely with a few hairs.

Bracts hirsute or both hirsute and glandular-puberulent.

Plant tall, 3-6 dm. high, apparently only biennial; heads numerous.

Plant low, 1-3 dm. high, perennial; heads few.

1. *E. minor*.

2. *E. lonchophyllus*.

3. *E. droebachiensis*.

4. *E. yellowstonensis*.

5. *E. jucundus*.

II. MULTIFIDI.

Leaves pinnately divided.

Leaves once to thrice ternately divided.

Leaves twice or thrice ternate.

Ultimate divisions of the leaves narrowly linear; peduncles with long linear leaves.

Ultimate divisions of the leaves spatulate or broadly oblanceolate; peduncles naked above or with very short leaves.

Leaves once ternate or quinate.

6. *E. pinnatisectus*.

7. *E. compositus*.

8. *E. multifidus*.

9. *E. trifidus*.

III. UNIFLORI.

Involucres and peduncles with black-purple hairs.

Involucres and peduncles white-hairy.

Plant 5-8 cm. high; disk 10-12 mm. wide.

Plant 1 dm. high or more; disk 13-15 mm. wide.

10. *E. melanocephalus*.

11. *E. uniflorus*.

12. *E. leucotrichus*.

IV. RADICATI.

Involucre glandular-puberulent or glabrate, not hirsute.

Stem and leaves glabrous or nearly so.

Stem and leaves pubescent and somewhat glandular.

Involucre more or less hirsute or strigose; in some also slightly glandular-puberulent.

Leaves and stem glandular-scabrous as well as hirsute.

Leaves and stem hirsute or strigose, not glandular.

Stem 1 dm. or more high, appressed-pubescent; disk over 1 cm. wide; branches of the caudex rather slender, purplish.

Leaves narrowly linear-oblanceolate, 1-3 mm. wide, strigose.

Leaves oblanceolate to linear-oblanceolate, 3-8 mm. wide, glabrous above except the margins.

Stem 4-7 cm. high; disk less than 1 cm. wide; caudex and its branches stout and short, not purplish.

Leaves linear-oblanceolate to spatulate.

Stem with appressed hairs.

Stem with more or less spreading hairs.

Leaves linear-filiform.

13. *E. leiomeris*.

14. *E. viscidus*.

15. *E. glandulosus*.

16. *E. Engelmannii*.

17. *E. ursinus*.

18. *E. Peasei*.

19. *E. vetensis*.

20. *E. nematophyllus*.

V. PUMILI.

Rays present.

Ray-flowers white; the outer pappus of small inconspicuous bristles.

Ray-flowers blue or purplish; outer pappus conspicuous and squamellate.

Rays wanting.

21. *E. aphanactis*.

22. *E. pumilus*.

23. *E. concinnus*.

24. *E. aphanactis*.

VI. DECUMBENTES.

Leaves 1-nerved, linear-oblongate; the lower usually obtusish.

Plant 1.5-2 dm. high; pubescence of the leaves sparse, loose.

22. *E. simulans*.

Plant 1 dm. high or less, usually monocephalous; pubescence dense and appressed.

23. *E. Engelmannii*.

Leaves 3-nerved, at least at the base, equally long-acuminate at both ends.

24. *E. microlonchus*.

VII. ELATIORES.

Bracts very densely villous; leaves entire.

25. *E. elatior*.

Bracts sparingly villous; leaves usually dentate.

26. *E. Coulteri*.

VIII. SALSUGINOSI.

One species.

27. *E. salsuginosus*.

IX. MACRANTHI.

Basal leaf-blades broadly obovate-spatulate, often denticulate; stem-leaves distant, shorter than the internodes, not ciliate on the margins; bracts glandular-puberulent, seldom with a few hairs.

28. *E. superbus*.

Basal leaf-blades oblanceolate, entire; stem-leaves usually longer than the internodes, usually ciliate on the margins.

Bracts glandular-puberulent, not at all hirsute; leaves glabrous.

Leaves linear-lanceolate, dark bluish green and shining, minutely ciliolate.

29. *E. salicinus*.

Leaves not dark-green, dull, strongly hirsute-ciliate.

30. *E. macranthus*.

Bracts more or less hirsute.

Stem and leaves glabrous or nearly so; the latter ciliate only on the margins and the veins below; bracts glandular-puberulent and with scattered hairs.

31. *E. speciosus*.

Stem and leaves hairy; bracts hirsute or both hirsute and glandular.

Leaves hirsute.

Pubescence scant; that of the stem long; leaves linear-lanceolate.

32. *E. conspicuus*.

Pubescence of the leaves and the involucre dense; that of the stem short.

Plant tall, green; upper stem-leaves ovate or ovate-lanceolate, distinctly triple-nerved.

33. *E. subtrinervis*.

Plant low, canescent; upper stem-leaves lanceolate, scarcely triple-nerved.

34. *E. incanescens*.

Leaves glandular-puberulent.

35. *E. Vreelandii*.

X. GLABELLI.

Involucre glandular-puberulent, sparingly if at all hairy.

Stem with long white hairs; the upper portion glandular-hirsute.

Lower leaves hairy; stem low, stout.

36. *E. viscidus*.

Leaves merely ciliate; stem slender.

37. *E. eximius*.

Stem glabrous; upper portion glandular-puberulent; leaves glabrate.

38. *E. Smithii*.

Involucre densely hirsute or strigose.

Bracts hirsute.

Leaves glabrate; plant evidently a perennial.

39. *E. glabellus*.

Leaves more or less hairy; plant in most cases apparently only biennial.

40. *E. consobrinus*.

Bracts strigose; basal leaves linear-oblongate, denticulate.

41. *E. strigosus*.

XI. RAMOSI.

One species.

42. *E. ramosus*.

XII. PHILADELPHICI.

One species.

43. *E. philadelphicus*.

XIII. BELLIDIASTRA.

One species.

44. *E. Bellidiastrum*.

XIV. DIVERGENTES.

Stem simple below.

45. *E. Wootonii*.

Stem branched at the base.

46. *E. divergens*.

XV. FLAGELLARES.

Leaves and stem appressed-hairy.

47. *E. flagellaris*.

Leaves and stem densely short-pubescent with spreading hairs.

Basal leaves oblanceolate, entire, or 3-lobed at the apex; leaves of the stolons linear; plant gray.

48. *E. cinereus*.

Basal leaves obovate-spatulate, entire, or with several lateral lobes or teeth; leaves of the stolons oblanceolate; plant greener.

49. *E. nudiflorus*.

XVI. CANI.

Disk of the heads fully 1 cm. high and about 1.5 cm. wide; basal leaves spatulate, obtuse.

50. *E. argentatus*.

Disk of the heads 7-8 mm. high and about 1 cm. wide; basal leaves oblanceolate, mostly acutish.

51. *E. canus*.

XVII. CAESPITOSI.

Stem erect, about 3 dm. high, usually with several heads; stem-leaves linear.

52. *E. subcanescens*.

Stem decumbent at the base, 1-2 dm. high, with 1-3 (seldom more) heads; stem-leaves oblong.

53. *E. caespitosus*.

1. *Erigeron minor* (Hook.) Rydb. (*E. armeriaefolius* A. Gray, in part; not Turcz.) In damp places in the mountains from Sask. and B. C. to Colo. and Utah.—Alt. 7000-10,000 ft.—Lake City; Democrat Mountain; Georgetown; South Park; Twin Lakes; Westcliffe; Red Mountain road, south of Ouray; Gunnison; Palsgrove Cañon; Clear Lake; Grand River, above Kremmling; Grizzly Creek; Pagosa Springs; Buena Vista; Buffalo Pass; near Como; Trappers' Lake.

2. *Erigeron lonchophyllus* Hook. (*E. armeriaefolius* A. Gray, in part) In wet places in the mountains from Sask. and Mont. to Colo. and Nev.—Alt. 8000-9000 ft.—Parlin; Ruxton Park, Pike's Peak; Higho; Table Rock; Gypsum Creek; Buena Vista; Grizzly Creek; Twin Lakes.

3. *Erigeron droebachiensis* Muell. (*E. acris Droebachiensis* Blytt) In dry woods from N. B. and Alaska to Colo.—Breckenridge; Mt. Harvard; Anita Peak.

4. *Erigeron yellowstonensis* A. Nels. (*E. acris* A. Gray, in part; not L.) In the mountains from Mont. to Colo.—Alt. 9000-10,000 ft.—Breckenridge; Chambers' Lake; Beaver Creek.

5. *Erigeron jucundus* Greene. (*E. acris debilis* A. Gray; *E. debilis* Rydb.) In wet places, especially in the mountains, from Hudson Bay and B. C. to Colo. and Utah.—Alt. 8000-11,000 ft.—Massif de l'Arapahoe; Mt. Baldy; headwaters of Clear Creek; Georgetown; Eldora to Baltimore.

6. *Erigeron pinnatisectus* (A. Gray) A. Nels. (*E. compositus pinnatisectus* A. Gray) On the higher peaks of Wyo. and Colo.—Alt. 10,000-13,500 ft.—Hahn's Peak; Cameron Pass; Pike's Peak; near Iron-ton, San Juan Co.; Gray's Peak; Mt. Garfield; Mt. Harvard; south of Ward, Boulder Co.; above Boreas; Bottomless Pit; Bald Mountain; Little Kate Mine, La Plata Mountains; near Pagosa Peak; Westcliffe; Devil's Causeway; Beaver Creek.

7. *Erigeron compositus* Pursh. On the mountains from Mont. and Yukon to Colo. and Wash.—Alt. 8000–9000 ft.—Mountains between Sunshine and Ward.

8. *Erigeron multifidus* Rydb. On the higher mountains from Ass. and B. C. to Colo. and Calif.—Alt. 5000–12,500 ft.—Headwaters of Clear Creek; Hinsdale Co.; West Indian Creek; west of Ft. Collins; Calhan; foot-hills, Larimer Co.; Marshall Pass; Sierra Blanca; Mt. Abram; Ouray; Pike's Peak; Stove Prairie; Eldora to Baltimore; Rist Cañon; Barnes' Camp; gulch east of Stove Prairie; Beaver Creek; Spicer.

9. *Erigeron trifidus* Hook. On high mountains from Alb. and B. C. to Colo.—Table Rock; Spicer, Larimer Co.

10. *Erigeron melanocephalus* A. Nels. (*E. oreocharis* Greene) On high mountains of Wyo. and Colo.—Alt. 11,000–12,000 ft.—Massif de l'Arapahoe; Caribou; headwaters of Clear Creek; Little Kate Mine, La Plata Mountains; near Pagosa Peak; Sierra Blanca; Mt. Harvard; Cameron Pass; Berthoud Pass; Argentine Pass; summit of North Park Range, Routt Co.

11. *Erigeron uniflorus* L. (*E. simplex* Greene) In arctic regions and on the higher peaks from Mont. to Colo. and Calif.—Alt. 10,000–13,000 ft.—Mt. McClellan, near Gray's Peak; West Spanish Peak; Bottomless Pit, Pike's Peak; Gray's Peak; above Cameron Pass; Marshall Pass; Seven Lakes; South Park; Alpine Tunnel; mountain northeast of Boreas.

12. *Erigeron leucotrichus* Rydb. On the higher mountains of Wyo. and Colo.—Alt. 9000–12,000 ft.—Caribou; headwaters of Clear Creek; Pike's Peak Valley; Cameron Pass; Seven Lakes; Graymont; Berthoud Pass; Beaver Creek.

13. *Erigeron leiomeris* A. Gray. (*E. spathulifolius* Rydb.) On alpine peaks from Wyo. to N. M. and Utah.—Alt. 10,000–12,000 ft.—Mt. Kelso; near Gray's Peak; Lake City; Redcliffe, Eagle Co.; mountains above Cameron Pass; Gray's Peak; Little Kate Mine, La Plata Mountains; Ragged Mountain, Gunnison Co.; Four-Mile Hill, Routt Co.; Hahn's Peak; Rabbit-Ears, Larimer Co.

14. *Erigeron glandulosus* Porter. On the mountains of Wyo. and Colo.—Alt. 6000–12,500 ft.—Hinsdale Co.; South Park; Alpine Tunnel; Georgetown; southeast of La Veta; east slope of Pike's Peak; Manitou; Garden of the Gods; near Colorado Springs; Palmer Lake; Cheyenne Cañon; Lake City; Empire; Colorado City.

15. *Erigeron ursinus* D. C. Eaton. On the mountains from Mont. and Ida. to Colo. and Utah.—Alt. 8000–10,000 ft.—Continental Divide, Routt Co.; Columbine; summit of North Park Range, Larimer Co.; Rabbit-Ears, Larimer Co.

16. *Erigeron Peasei* Rydb. In alpine regions of Colo.—Lake City.

17. *Erigeron vetensis* Rydb. On high, dry mountains of southern Colo.—Alt. 8000–10,000 ft.—Mountain near Veta Pass; Ojo; West Spanish Peak; Veta Mountain; North Cheyenne Cañon.

18. *Erigeron nematophyllus* Rydb. On rocky hills of Colo. and Wyo.—Near Dale Creek, Larimer Co.

19. *Erigeron pumilus* Nutt. On the plains from N. D. and Wash. to Kans. and Utah.—Alt. 4000–7000 ft.—Moon's ranch; Cucharas River, La Veta; Ft. Collins; Antonito; New Windsor; Mancos; Palisades; Gypsum; Quimby; Wray.

20. *Erigeron concinnus* (H. & A.) T. & G. On arid plains and hills from Mont. and B. C. to N. M. and Calif.—Alt. 4000-7000 ft.—Mancos; Grand Junction; Los Pinos (Bayfield); Durango; Dolores.

21. *Erigeron aphanactis* (A. Gray) Greene. (*E. concinnus aphanactis* A. Gray) On dry plains from Colo. and Nev. to Calif.—Antonito; Grand Junction.

22. *Erigeron simulans* Greene. (*E. Engelmannii arenicola* A. Nels.) On dry hills and sandy flats from Mont. to Colo. and Utah.—Alt. 6000-8000 ft.—Glenwood Springs; Cimarron; Gunnison; Salida; Buena Vista.

23. *Erigeron Engelmannii* A. Nels. On dry plains of Wyo. and Colo.—Gunnison; Gypsum; Table Rock.

24. *Erigeron microlonchus* Greene. On dry plains from Wyo. to Colo. and Ariz.—Alt. about 7000 ft.—Cimarron.

25. *Erigeron elatior* (A. Gray) Greene. (*E. grandiflorum elatior* A. Gray) In wet places in the mountains of Wyo. and Colo.—Alt. 8000-12,000 ft.—Red Mountain; Silver Plume; Mt. Baldy; near Pagosa Peak; east side of Bald Mountain; Georgetown; Rabbit-Ear Pass; White River Plateau; Steamboat Springs; near Teller, North Park; Ruby; Villa Park; Boreas; Leroux Park; Rabbit-Ear Range, Routt Co.; near Empire; headwaters of Clear Creek; Robinson; Red Mountain; Silver Plume; Berthoud Pass.

26. *Erigeron Coulteri* Porter. In damp places in the mountains of Colo. and Utah.—Alt. 9000-12,000 ft.—Lake City; Hinsdale Co.; Bard Valley, near Empire; Bob Creek, west of Mt. Hesperus; Rabbit-Ear Pass; La Plata Cañon; Leroux Creek, Delta Co.; East River; near Pagosa Peak; Red Mountain, about Ouray; Ironton, San Juan Co.; Mt. Harvard; Ironton Park, nine miles south of Ouray; Silverton; Berthoud Pass.

27. *Erigeron salsuginosus* (Richardson) A. Gray. In wet ground from Alb. and Alaska to Colo. and Calif.—Alt. 9000-12,000 ft.—Middle Park; Chambers' Lake; Georgetown; near Pagosa Peak; Minnehaha; Lake Moraine; Cameron Pass; Marshall Pass; mountains above Ouray; Hahn's Peak; Mt. Harvard; Red Mountain; Ruby; Ruxton Park, Pike's Peak; Silver Plume; Beaver Creek; Trappers' Lake; Berthoud Pass; Buffalo Pass; Gray's Peak; between Como and Boreas; Twin Lakes; Devil's Causeway; summit of North Park Range, Larimer Co.; Hahn's Peak.

Erigeron salsuginosus glacialis (Nutt.) A. Gray. In the higher mountains from Wyo. to N. M. and Utah.—Alt. 9000-12,000 ft.—High Mountains, near Empire; Caribou; Veta Pass.

28. *Erigeron superbus* Greene. In the mountains of Colo.—Alt. 7500-12,000 ft.—Mountains near Empire; near Pagosa Peak; Minnehaha; Breckenridge; Villa Grove; Idaho Springs; Artist's Glen and Halfway House, Pike's Peak; Box Cañon, west of Ouray; Baxter's ranch; chaparral-covered hills southeast of Ouray; mountains between Sunshine and Ward; Stove Prairie Hill; Marshall Pass.

29. *Erigeron salicinus* Rydb. In the mountains of Colo.—Alt. up to 10,000 ft.—Pagosa Springs; Keblar Pass; Narrows.

30. *Erigeron macranthus* Nutt. In the mountains from Mont. and B. C. to Colo., Utah and Ore.—Alt. 7000-10,000 ft.—Lake City; Platte River; west of Ouray; Jack's Cabin; Steamboat Springs; Keblar Pass; Durango; Cerro Summit; mountains, Larimer Co.; La Veta; La Plata Cañon; Mancos; Sun-

set, Boulder Co.; Four-mile Hill, Routt Co.; Andrews' Shetland ranch; Mt. Abram, Ouray; southeast of Ouray; Veta; Bosworth's ranch; Poudre Cañon, near Narrows; Table Rock; Little Muddy; Hotchkiss; Eldora to Baltimore; Stove Prairie; Redstone; Cheyenne Cañon; Palmer Lake; Bosworth's ranch, Stove Prairie; gulch west of Soldier Cañon; Vance Junction; Hahn's Peak; Willow Creek; Steamboat Springs.

31. *Erigeron speciosus* (Lindl.) DC. In the mountains from Mont. and Wash. to Colo., Utah and Ore.—Alt. 7500-9000 ft.—Castle Cañon; Minnehaha; chaparral-covered hills southeast of Ouray; mountains between Sunshine and Ward; Cheyenne Cañon.

32. *Erigeron conspicuus* Rydb. In mountain meadows from Mont. and Wash. to Colo.—Deep Creek Lake; Pine Grove; North Park, along the Michigan.

33. *Erigeron subtrinervis* Rydb. (*E. glabellus mollis* A. Gray, in part) Wooded mountain sides and dry places in the valleys from S. D. and Wyo. to N. M.—Alt. 7000-10,000 ft.—Near Empire; Gray's Peak; Grizzly Creek; North Park; Twin Lakes; Dark Cañon; North Cheyenne Cañon; Steele Cañon; Villa Grove; Echo Creek; Empire; Pine Grove.

34. *Erigeron incanescens* Rydb. (*E. glabellus mollis* A. Gray, in part) High mountains of Colo.—Alt. 9000-10,000 ft.—West Spanish Peak; Sargent.

35. *Erigeron Vreelandii* Rydb. In wet meadows of southern Colo.—Alt. 7500 ft.—Wahatoya Creek.

36. *Erigeron viscidus* Rydb. On mountain ridges in Colo.—Alt. 8500-12,000 ft.—Piedra; Grayback mining camps and Placer Gulch; Ruxton Dell; Poudre River; Berthoud Pass; Boreas.

37. *Erigeron eximius* Greene. In the mountains of Colo.—Alt. 8000-10,000 ft.—Piedra; Poudre Cañon, above Rustic; Eldora to Baltimore; Poudre flats.

38. *Erigeron Smithii* Rydb. In rich meadows of Colo.—Alt. 7000-10,000 ft.—Parlin, Gunnison Co.; Gunnison; Antonito; Sargent; Villa Grove; Arkansas Junction.

39. *Erigeron glabellus* Nutt. On mountains and hills from Sask. and Mackenzie to Wisc. and N. M.—Alt. 5000-12,000 ft.—Hinsdale Co.; McCoy; Marshall Pass; Ft. Collins; Ribbon Lake; Clear Creek, below Georgetown; east bank of Poudre River, near Ft. Collins; Gypsum Creek Cañon; bank of Elk River.

40. *Erigeron consobrinus* Greene. (*E. fraternus* Greene) In mountain valleys of Colo.—Alt. 7000-10,000 ft.—Villa Grove; Gunnison; Cucharas River, below La Veta; Sangre de Cristo Creek; Wahatoya Creek; Alamosa; Garland; Parlin, Gunnison Co.; Estes Park, Larimer Co.; Cerro Summit; Como; vicinity of Como; Walton Creek; Conejos River; Steamboat Springs.

41. *Erigeron strigosus* Rydb. In meadows of Colo.—Antonito.

42. *Erigeron ramosus* (Walt.) B. S. P. (*E. strigosus* Muhl.) In dry places from N. S. and B. C. to Fla. and Calif.—Alt. 5000-6500 ft.—Foot-hills, Larimer Co.; Boulder; Rist Cañon; Horsetooth Mountain; Arthur's Rock; Redstone.

43. *Erigeron philadelphicus* L. In wet fields and woodlands from Lab. and B. C. to Fla. and Calif.—Piedra; Poudre Cañon.

44. *Erigeron Bellidiastrum* Nutt. In low grounds from S. D. and Wyo. to Kans. and Ariz.—Alt. about 9000 ft.—McElmo Cañon.

45. *Erigeron Wootonii* Rydb. (*E. cinereus* var. γ A. Gray) In sandy soil from Colo. to N. M. and Ariz.—Alt. up to 7000 ft.—Walsenburg; Antonito; Grand Lake; Garden of the Gods.

46. *Erigeron divergens* T. & G. Low plains and river banks from Mont. and Wash. to N. M. and Calif.—Alt. 5000–8500 ft.—Golden City; Steamboat Springs; Durango; Mancos; Arboles; Ouray; Cedar Edge; Sargent; Hohnold; Hotchkiss; Big Creek Gulch; Empire; Boulder; Buena Vista; Colorado Springs.

47. *Erigeron flagellaris* A. Gray. (*E. stolonifer* Greene) On banks of streams and river valleys from S. D. and Wyo. to N. M. and Utah.—Alt. 5000–11,000 ft.—Durango; Ft. Collins; southeast of Ouray; Cucharas River, below La Veta; Arboles; Mancos; headwaters of Sangre de Cristo Creek; Bob Creek, west of Mt. Hesperus; Como; Calhan; Red Rock Cañon; Boulder; Middle Park; Veta Pass; Sargent; Columbine; Boulder; Castle Cañon; Walsenburg; Como; Trappers' Lake; Poudre, near the Narrows; Eldora to Baltimore; bank of Purgatory River, near Trinidad; Moon's ranch; Poudre Cañon; Horsetooth Gulch; Quimby; Howe's Gulch.

48. *Erigeron cinereus* A. Gray. (*E. divergens cinereus* A. Gray) On river bluffs from Colo. and Utah to Tex. and Ariz.—Alt. 6500–7500 ft.—Manitou; river bluffs north of La Veta; Los Pinos (Bayfield); Arboles.

49. *Erigeron nudiflorus* Buckl. Hills and river bluffs from Colo. to Tex. and Ariz.—Alt. 7000–8000 ft.—Ft. Collins; butte, five miles southeast of La Veta; Quimby; Horsetooth Mountain; Horsetooth Gulch.

50. *Erigeron argentatus* A. Gray. On dry plains from Mont. and Wash. to Col. and Nev.—Grand Junction.

51. *Erigeron canus* A. Gray. On dry plains from S. D. and Wyo. to Neb. and N. M.—Alt. 4000–9000 ft.—Near Empire; Colorado Springs; Sunset Cañon; Lake City; Sangre de Cristo Creek; Grayback mining camps and Placer Gulch; Mancos; Almelia.

52. *Erigeron subcanescens* Rydb. On dry plains from Mont. and Alb. to Colo.—North Park.

53. *Erigeron caespitosus* Nutt. On dry plains from Sask., Yukon and B. C. to Colo.—Alt. about 9500 ft.—Chambers' Lake.

32. LEPTILON Raf. HORSEWEED, CANADA FLEABANE

1. *Leptilon canadense* (L.) Britton. (*Erigeron Canadense* L.) In waste places and dry soil from Lab. and B. C. to Fla. and Calif.; also in W. Ind. and Mex. and introduced in Europe.—Alt. 4000–8000 ft.—Gunnison; Minnehaha; Box Cañon, west of Ouray; Ft. Collins; North Cheyenne Cañon.

33. ESCHENBACHIA Moench.

1. *Eschenbachia Coulteri* (A. Gray) Rydb. (*Conysa Coulteri* A. Gray) On river bottoms from Colo. to Tex. and Calif.—Cañon City (*Brandegei*).

34. BACCHARIS L. GROUNDSEL TREE, PENCIL TREE

Pappus copious, in fruit elongating and surpassing the styles.

Pappus-bristles in several series; plant 3–6 dm. high, herbaceous with a woody base.

1. *B. Wrightii*.

Pappus-bristles in one series; plants 1-5 m. high, shrubby.

Fertile heads hemispherical, 5-10 mm. broad; bracts all acute.

2. *B. salicina*.

Fertile heads deeply campanulate, 3-5 mm. broad; outer bracts obtuse.

3. *B. Emoryi*.

Pappus scant, little if at all elongating, in fruit not exceeding the styles.

4. *B. glutinosa*.

1. *Baccharis Wrightii* A. Gray. In saline soil from Kans. and Colo. to Tex. and Ariz.; also in Mex.—Brantly Cañon, Las Animas Co.; Soda Spring ledge, Fremont Co.

2. *Baccharis salicina* T. & G. In saline soil from Kans. and Colo. to Tex. and N. M.—Alt. 4000-5000 ft.—Rocky Ford, Otero Co.; Grand Junction; Cañon City.

3. *Baccharis Emoryi* A. Gray. Along rivers, especially in saline ground, from Colo. to N. M. and Calif.—Alt. about 4600 ft.—Grand Junction.

4. *Baccharis glutinosa* Pers. Along streams from Colo. to Tex. and Calif.; also in Mex.—Grand Junction; Grand Cañon; Peoria Creek.

Tribe 4. GNAPHALIAE.

35. BERTHELOTIA DC.

1. *Berthelotia sericea* (Nutt.) Rydb. (*Polypappus sericeus* Nutt.; *Pluchea borealis* A. Gray) On sandy banks of streams from Colo. and Utah to Tex. and Calif.; also in Mex.—Grand Cañon.

36. FILAGO L.

1. *Filago prolifera* (Nutt.) Britton. (*Evax prolifera* Nutt.) On dry ground from S. D. and Colo. to La. and Tex.—Plains near Greeley; New Windsor.

37. ANTENNARIA Gaertn. CAT'S-FOOT, EVERLASTING.

Pappus-bristles of the staminate heads with clavate or scarious-dilated tips.

Plants surculose-proliferous with leafy stolons.

Plant caulescent.

Bracts of the involucre with green or brown upper portion.

Bracts dark; leaves not yellowish.

Bracts of the heads lanceolate, acute.

(Pistillate heads of) 1. *A. media*.

Bracts oblong or oval, obtuse.

Bracts very dark, almost black at the base, but often with white tips.

(Staminate heads of) 1. *A. media*.

Bracts moderately dark, umber-colored throughout.

2. *A. umbrinella*.

Bracts isabel-colored; leaves yellowish-white.

Inner bracts not rose-colored.

3. *A. flavescens*.

Inner bracts rose-colored.

4. *A. concinna*.

Bracts of the involucre with white or pink upper portion.

Heads 5-8 mm. high.

Bracts usually with bright pink upper portion.

Leaves narrowly oblanceolate, acute.

5. *A. rosea*.

Leaves spatulate, obtuse.

6. *A. imbricata*.

Bracts with white upper portion.

Leaves of the stolons narrowly oblanceolate, 1.5-5 cm. long; bracts with dark spots. 7. *A. nardina*.

Leaves of the stolons spatulate, 0.5-3 cm. long; bracts not with dark spots.

Leaves of the stolons 5-15 mm. long, rhombic-spatulate; tomentum very fine, appressed and silky. 8. *A. microphylla*.

Leaves of the stolons spatulate, usually rounded at the apex, 15-30 mm. long; tomentum looser.

Bracts of the pistillate heads obtuse; plant 1-2 dm. high.

9. *A. viscidula*.

Bracts of the pistillate heads acute.

Inflorescence and upper leaves glandular-hairy; leaves of the inflorescence large, scarcely smaller than the upper stem-leaves; bracts greenish. 10. *A. bracteosa*.

Inflorescence and upper leaves not glandular; the latter reduced; bracts brownish. 11. *A. oxyphylla*.

Heads 8-12 mm. high.

Leaves tomentose on both sides.

Plant tall, 2-3 dm. high; heads usually peduncled.

Leaves less than 2 cm. long and 5-8 mm. wide, usually not triple-nerved; heads 7-9 mm. high. 11. *A. oxyphylla*.

Leaves over 2 cm. long, 7-10 mm. wide, triple-nerved; heads about 1 cm. high. 12. *A. obovata*.

Plant low, usually less than 1 dm. high; heads subsessile.

13. *A. aprica*.

Leaves glabrous above.

14. *A. marginata*.

Plant acaulescent; heads subsessile among the rosettes of the basal leaves.

Bracts with white upper portion; leaves white on both sides.

15. *A. rosulata*.

Bracts with brown upper portion; leaves glabrate above.

16. *A. Sierrae-Blancae*.

Plants not surculose-proliferous.

Heads 4-5 mm. high; bracts nearly glabrous, scarious throughout; leaves silky-tomentose. 17. *A. oblanceolata*.

Heads 6-10 mm. high; bracts tomentose at the base; only tips scarious; leaves villous-tomentose.

Bracts with a large dark spot; those of the pistillate heads ovate to lanceolate, acute; those of the staminate heads ovate or oval, obtuse or acutish; pistillate heads about 8-10 mm. high, turbinate at the base.

18. *A. pulcherrima*.

Bracts with small dark spots or none; bracts of both staminate and pistillate heads with oblong or oval, obtuse tips; those of the staminate heads slightly broader. 19. *A. anaphaloides*.

Pappus-bristles of the staminate heads not clavate; achenes puberulent; hairs bifurcate at the apex; plant low and densely cespitose. 20. *A. dimorpha*.

1. *Antennaria media* Greene. On the higher peaks from Mont. and B. C. to Colo. and Calif.—Alt. 10,000-13,000 ft.—Massif de l'Arapahoe; Little Kate Basin, La Plata Mountains; Alpine Tunnel; West Spanish Peak; near Pagosa Peak; Bottomless Pit; Silver Plume; mountain southeast of Cameron Pass.

2. *Antennaria umbrinella* Rydb. On the higher mountains from Mont. and Ida. to Colo.—Alt. 7500-13,000 ft.—Ruxton Dell; Alpine Tunnel; Sierra Blanca; Little Kate Basin; divide road to Steamboat Springs; Gunnison; Ironton, San Juan Co.; Berthoud Pass.

3. *Antennaria flavescens* Rydb. On dry hills from Mont. and Wash. to Colo.—Alt. up to 10,500 ft.—Hahn's Peak; Spicer.

4. *Antennaria concinna* E. Nels. On mountain ridges of Colo. and Utah.—Alt. about 9000 ft.—Palsgrove Cañon.

5. *Antennaria rosea* (D. C. Eaton) Greene. (*A. parviflora* Rydb.; not Nutt.) In meadows from Alb. and Yukon to Colo. and Calif.—Alt. 6000–11,000 ft.—Lake City; Empire City; North Boulder Peak; Pike's Peak; Mt. Hesperus; headwaters of Pass Creek; Crested Butte; Mt. Abram, Ouray; Upper La Plata River; gulch west of Pennock's; Eldora to Baltimore; Horsetooth Mountain.

6. *Antennaria imbricata* E. Nels. On hillsides from Mont. to Colo. and Utah.—Alt. 6000–10,000 ft.—West Mancos Divide; Palsgrove Cañon; Ruxton Dell; Rist Cañon; Chambers' Lake.

7. *Antennaria nardina* Greene. (*A. corymbosa* E. Nels.) In meadows from Mont. and Ore. to Colo.—Alt. up to 12,000 ft.—Lake City; Seven Lakes.

8. *Antennaria microphylla* Rydb. (*A. parvifolia* Greene; not Nutt.; *A. formosa* Greene) On dry plains and hills from Sask. and B. C. to Neb. and N. M.—Alt. 4000–11,000 ft.—Pike's Peak; Empire City; Lake City; Wahatoya Creek; Gunnison; Dark Cañon; Piedra; Seven Lakes; Wolcott, Eagle Co.; Alamosa; Parlin; Boulder; Ft. Collins; south of Walden; Ruxton Dell.

9. *Antennaria viscidula* A. Nels. On mountains of Wyo. and Colo.—Alt. 9000–13,000 ft.—West Spanish Peak; Cabin Cañon.

10. *Antennaria bracteosa* Rydb. In mountain meadows from Mont. to Colo.—Alt. 8000–9000 ft.—Colorado Springs; Mt. Hesperus; Sangre de Cristo Creek.

11. *Antennaria oxyphylla* Greene. On hills and mountains from S. D. and Mont. to Neb. and Colo.—Alt. up to 11,000 ft.—Mt. Abram, Ouray; gulch west of Pennock's.

12. *Antennaria obovata* E. Nels. On hills and mountains from S. D. to Colo.—Soldier Cañon; Palmer Lake.

13. *Antennaria aprica* Greene. (*A. dioica* Hook.; not Gaert.) On hills and mountains from S. D. and Alb. to N. M. and Utah.—Alt. 5000–12,000 ft.—Lake City; Pike's Peak; Van Boxie's ranch, above Cimarron; Los Pinos; Veta Mountain; Turkey Creek and tributaries; Wahatoya Cañon; West Indian Creek; Sangre de Cristo Creek; East Indian Creek; north of La Veta; Ojo; Cucharas River, below La Veta; southeast of La Veta; Palmer Lake; Howe's Gulch; North Cheyenne Cañon; La Plata Cañon; Mancos; Chicken Creek, west of Mt. Hesperus; near Denver; Grayback mining camps and Placer Gulch; Mt. Hesperus; Horsetooth Gulch; Howe's Gulch; Horsetooth Mountain; Eldora to Baltimore; Beaver Creek.

14. *Antennaria marginata* Greene. On the mountains of Colo., N. M. and Ariz.—Alt. 10,000–11,000 ft.—Little Veta Mountain.

15. *Antennaria rosulata* Rydb. In mountain valleys of Colo. and Ariz.—Alt. 7000–8000 ft.—Wahatoya Creek; Los Pinos (Bayfield).

16. *Antennaria Sierra-Blancae* Rydb. On alpine peaks of Southern Colo.—Alt. 12,000–13,000 ft.—Sierra-Blanca.

17. *Antennaria oblanceolata* Rydb. On mountain sides from Mont. and B. C. to Colo. and Calif.—Alt. up to 10,000 ft.—Mountains west of North Park; Buffalo Pass; Park Range; Walton Creek, Routt Co.

18. *Antennaria pulcherrima* (Hook.) Greene. (*A. Carpatica pulcherrima* Hook.) On hillsides from Sask. and Yukon to Colo. and Wash.—Alt. up to 9000 ft.—Hamor's Lake.

19. *Antennaria anaphaloides* Rydb. On hillsides from Mont. to Colo. and Ore.—Alt. 8000–11,000 ft.—Engelmann's Cañon; Massif de l'Arapahoe; Crystal Park; Iron Mountain; near Veta Pass; Marshall Pass; Manitou; Artists' Glen; West Indian Creek; Green Mountain Falls; Soldier Cañon; Howe's Gulch; gulch west of Pennock's; Stove Prairie.

20. *Antennaria dimorpha* T. & G. On dry hills from Mont. and B. C. to Neb., Colo. and Nev.—Alt. about 7000 ft.—Cimarron.

38. ANAPHALIS D. C. PEARLY EVERLASTING.

1. *Anaphalis subalpina* (A. Gray) Rydb. (*A. margaritacea subalpina* A. Gray) In open mountain woods from S. D. and B. C. to Colo. and Calif.—Alt. 8000–11,000 ft.—Empire City; Middle Park; Cameron Pass; La Plata Cañon; near Pagosa Peak; Red Mountain road, south of Ouray; Sangre de Cristo; Ruby; Stove Prairie Hill; Empire; between Sunshine and Ward; Ft. Collins; Fish Creek Falls.

39. GNAPHALIUM L. CUDWEED, EVERLASTING.

Heads not leafy-bracted; involucre well imbricated; its bracts scarious, white or tinged with brownish, rose or yellow; plants mostly tall.

Leaves tomentose on both sides; plants little if at all glandular.

Leaves narrowed at the base, not at all decurrent.

1. *G. Wrightii*.

Stem-leaves not narrowed at the base, more or less decurrent, or at least auricled.

2. *G. sulphurescens*.

Leaves on the upper surface green and decidedly glandular, decurrent.

3. *G. decurrens*.

Heads leafy-bracted; involucre little imbricated; its bracts brown or greenish; plant low.

Plants loosely floccose; leaves broad, spatulate, oblong or oblanceolate.

4. *G. palustre*.

Plants appressed-tomentose; leaves except the lowest narrowly oblanceolate or linear.

Stem diffusely branched; glomerules crowded, cymosely disposed.

Upper leaves narrowly oblanceolate.

5. *G. uliginosum*.

Upper leaves narrowly linear.

6. *G. angustifolium*.

Stem mostly simple, erect; glomerules spicately disposed.

7. *G. strictum*.

1. *Gnaphalium Wrightii* A. Gray. On dry ground from Colo. to N. M. and Calif.; also in Mex.—Meadow Park; Lyons.

2. *Gnaphalium sulphurescens* Rydb. In sandy soil from northern Wyo. and Wash. to Tex. and N. M.—Alt. 5000–6000 ft.—Poudre, near La Porte; Ft. Collins; Boulder; New Windsor.

3. *Gnaphalium decurrens* Ives. In open ground from N. S. and Ida. to Pa. and Colo.—Alt. 6000–10,000 ft.—Greeley; Marshall Pass; Ouray; Box Cañon, west of Ouray; Horsetooth Gulch; Steamboat Springs.

4. *Gnaphalium palustre* Nutt. In wet places from Mont. and B. C. to Colo. and Calif.—Alt. 5000–7500 ft.—Alamosa; twenty miles below Steamboat Springs; along Bear River; Gunnison; Hotchkiss.

5. *Gnaphalium uliginosum* L. In wet places from Newf. and B. C. to Va., Colo. and Ore.—Twin Lakes.

6. *Gnaphalium angustifolium* A. Nels. In wet places in Wyo. and Colo.—Alamosa; Honnold; North Platte River, near Hebron.

7. *Gnaphalium strictum* A. Gray. In wet places from Wyo. to Colo. and Ariz.—Alt. 5000-10,000 ft.—Buena Vista; Ruxton Dell; below Hot Sulphur Springs; near Pagosa Peak; Denver; Empire; Ft. Collins; Bosworth's ranch; Poudre River; Twin Lakes; Ft. Garland; Georgetown.

Tribe 4. HELIANTHEAE.

40. MELAMPODIUM L.

1. *Melampodium leucanthum* T. & G. (*M. cinereum* A. Gray, in part; not DC.) On dry plains from Colo. to Tex. and Ariz.—Alt. 5000-8000 ft.—Rocky Ford, Otero Co.; Cañon City; near Badito; Walsenburg; Pueblo; Florence.

41. PARTHENICE A. Gray.

1. *Parthenice mollis* A. Gray. On hillsides along the stream from Colo. to Ariz.—“Southern Colorado.”

42. CRASSINA Scepín. ZINNIA.

Ligules of the rays large, much longer than the disk.
Ligules of the rays scarcely longer than the disk.

1. *C. grandiflora*.
2. *C. anomala*.

1. *Crassina grandiflora* (Nutt.) Kuntze. (*Zinnia grandiflora* Nutt.) Plains from Colo. to Tex. and Ariz.—Alt. 5000-6000 ft.—Pueblo; Trinidad; Walsenburg; Arkansas River; Raton Range.

2. *Crassina anomala* (A. Gray) Kuntze. (*Zinnia anomala* A. Gray) On plains from Colo. to Tex. and Mex.—Pueblo.

43. HELIOPSIS Pers. OX-EYE.

1. *Heliopsis scabra* Dunal. On dry soil and river banks from Me. and B. C. to N. M.—Alt. 7000-8000 ft.—Wahatoya Creek; La Veta.

44. BRAUNERIA Necker. PURPLE CONE-FLOWER.

1. *Brauneria angustifolia* (DC.) Heller. On prairies from Minn. and Mont. to Tex.—Exact locality not given.

45. GYMNOLOMIA H. B. K.

1. *Gymnolomia multiflora* (Nutt.) B. & H. On plains and banks of streams from Mont. and Nev. to N. M. and Ariz.—Alt. 6000-10,000 ft.—Colorado Springs; Hahn's Peak; Veta Pass; southeast of Ouray; Iron-ton Park, nine miles south of Ouray; Manitou; Marshall Pass; Chester; Four-Mile Hill, Routt Co.; Golden; near Pagosa Peak; Lower Boulder Cañon, Boulder Co.; Cerro Summit; Big Creek Gulch; between Sunshine and Ward; Palmer Lake; Hotchkiss; Cimarron and Squaw Hill; La Veta; Ute Pass; Steamboat Springs.

46. RUDBECKIA L. CONE-FLOWER, BLACK-EYED SUSAN.

Heads radiate; disk in fruit spherical or oblong.

Leaves entire or merely toothed; plant hispid.

Leaves except the uppermost 3-5-cleft or pinnatifid; plant glabrous or nearly so.

Basal leaves and lower stem-leaves pinnately 5-7-divided.

Basal leaves and lower stem-leaves palmately ternate.

Heads discoid; disk in fruit cylindraceous.

1. *R. flava*.

2. *R. laciniata*.

3. *R. ampla*.

4. *R. montana*.

1. *Rudbeckia flava* Moore. (*R. hirta* A. Gray, in part; not L.) On hillsides from N. D. and Wyo. to Colo.—Alt. 5000-10,000 ft.—Pike's Peak; Gunnison; Idaho Springs; South Park; Ruxton Dell; Engelmann Cañon; Sangre de Cristo Creek; North Cheyenne Cañon; mountains, Larimer Co.; Georgetown; Parlin; Baxter's ranch; Bosworth's ranch; Stove Prairie; Moon's ranch; Ute; Pingree Hill; Poudre River; Laramie River; Rist Cañon.

2. *Rudbeckia laciniata* L. In wet places from Que. and Ida. to Fla. and Ariz.—Alt. 4000-9500 ft.—Durango; Williams' Cañon; mountains, Larimer Co.; Pagosa Springs; along Uncompahgre River, near Ouray; Ouray; Parlin, Gunnison Co.; Boulder; Ft. Collins; Big Creek Gulch; Bosworth's ranch, Stove Prairie; Elk Cañon; Long Gulch.

3. *Rudbeckia ampla* A. Nels. On river banks in Wyo. and Colo.—Baxter's ranch; Poudre River flats; Ft. Collins.

4. *Rudbeckia montana* A. Gray. In the mountains of Colo.—Wolcott, Eagle Co.; Gunnison Co.; Elk Mountains.

47. RATIBIDA Raf. CONE-FLOWER.

Disk in fruit oblong, about 1 cm. long; pappus of 1 or 2 awn-like teeth without intermediate squamellae.

1. *R. Tagetes*.

Disk in fruit cylindraceous, 2-4 cm. long; pappus with a series of squamellae.

2. *R. columnaris*.

1. *Ratibida Tagetes* (James) Barnhart. (*Lepachys Tagetes* A. Gray) On plains from Kans. and Colo. to Tex. and Ariz.; also in Mex.—Alt. 4000-7500 ft.—Cañon City; Iola; Cheyenne Wells.

2. *Ratibida columnaris* (Sims) D. Don. (*Lepachys columnaris* T. & G.) On plains from Sask. and B. C. to Tenn., Tex. and Ariz.; also in Mex.—Alt. 4000-6000 ft.—Ute Pass, near Pike's Peak; Ft. Collins; Denver; Piedra; New Windsor, Weld Co.; Boulder; Horsetooth Gulch.

Ratibida columnaris pulcherrima (DC.) D. Don. Rays at least partly purple.—Ft. Collins.

48. BALSAMORRHIZA Hook. BALSAM-ROOT.

1. *Balsamorhiza sagittata* (Pursh) Nutt. On hillsides from Alb. and B. C. to Colo. and Calif.—Alt. 7000-8000 ft.—Cerro Summit; Cimarron.

49. WYETHIA Nutt.

Involucral bracts nearly equal, in 2-3 series; stem not white.

Plant glabrous.

Plant densely pubescent.

1. *W. amplexicaulis*.

2. *W. arizonica*.

Involucral bracts unequal, the outer much shorter in 5-6 series; stem white.

3. *W. scabra*.

1. *Wyethia amplexicaulis* Nutt. In mountain valleys from Mont. and B. C. to Colo. and Nev.—Alt. about 9000 ft.—Rogers; divide road to Steamboat Springs; Honnold; Continental Divide, Routt Co.; Arapahoe Pass; Camp Creek; Spicer.

2. *Wyethia arizonica* A. Gray. Near mountain streams from Colo. and Utah to Ariz.—Alt. 7000-8000 ft.—Mancos; Cerro Summit; Rifle, Garfield Co.; Los Pinos (Bayfield); Chicken Creek, west of Mt. Hesperus; Dolores; Gunnison Co.

3. *Wyethia scabra* Hook. Dry plains from Wyo. to N. M. and Utah.—Alt. about 5000 ft.—La Plata Valley; base of Carisa (*Brandege*).

50. **HELIANTHUS** L. SUN-FLOWER.

Annuals; leaves broad, ovate or cordate or lanceolate; disk purple.

Bracts ciliate, hispid, ovate or obovate, abruptly acuminate.

Lower leaves, at least, ovate or cordate, distinctly toothed.

Leaves lanceolate or narrowly deltoid, minutely toothed or entire.

Bracts not ciliate, canescent-strigose, lanceolate.

Perennials.

Disk dark brown or purple.

Leaves linear.

Leaves rhombic-ovate.

Disk yellow or light brownish.

Bracts broadly lanceolate, acute, appressed.

Bracts narrowly lanceolate, acuminate, more or less spreading or squarrose.

Stem more or less scabrous or hispid; the upper leaves subsessile.

Leaves and stem very scabrous.

Leaves scabrous above, hirsute beneath; stem more or less hirsute.

Stem, except the upper portion, glabrous and glaucous (rarely hirsute with few hairs); leaves mostly all petioled.

Leaves coarsely toothed; bracts hirsute-ciliate.

Leaves distantly and minutely denticulate or subentire; bracts not ciliate or ciliate merely at the base.

1. *H. lenticularis*.

2. *H. aridus*.

3. *H. petiolaris*.

4. *H. orgyalis*.

5. *H. subrhomboides*.

6. *H. pumilus*.

7. *H. Maximiliani*.

8. *H. giganteus*.

9. *H. grosseserratus*.

10. *H. fascicularis*.

1. *Helianthus lenticularis* Dougl. (*H. annuus* A. Gray, in part; not L.) On plains and in alluvial soil from N. D. and Ida. to Tex. and Ariz.—Alt. 4000–7000 ft.—Cañon City; Valley Spur; Black Cañon; Ft. Collins; valley of Upper Arkansas River; Huerfano Valley, near Gardner; Boulder; Pennock's mountain ranch.

2. *Helianthus aridus* Rydb. In arid soil from Mont. to Neb. and N. Mex.—Alt. 4000–7000 ft.—Manitou.

3. *Helianthus petiolaris* Nutt. On dry plains and in waste places from Minn., Sask., Mont. and Ore. to Tex. and Calif.—Alt. 4000–10,000 ft.—Colorado Springs; Ft. Collins; Boulder; Eldora to Baltimore; Wray.

4. *Helianthus orgyalis* DC. On plains from Mo. and Colo. to Tex.—Southeastern Colorado.

5. *Helianthus subrhomboides* Rydb. (*H. rigidus* A. Gray, in part) On plains from Man., Sask. and Mont. to Colo. and Neb.—Alt. 4000–8000 ft.—La Pagosa; mountains, Larimer Co.; near Pagosa Peak; Cheyenne Mountain; Bosworth's ranch, Stove Prairie; Boulder; cañon west of Palmer Lake; Horsetooth Mountain.

6. *Helianthus pumilus* Nutt. On plains and mountains of Wyo. and Colo.—Alt. 5000–7500 ft.—Idaho Springs; Cañon City; New Windsor; Golden; Trail Glen; Horsetooth Gulch; Boulder; Harden's ranch; foot-hills, Dixon Cañon; hill south of Horsetooth Mountain; Bosworth's ranch, Stove Prairie; gulch west of Pennock's; Spring Cañon.

7. *Helianthus Maximiliani* Schrad. On prairies and in river valleys from Man. and Wyo. to Tex.—Alt. 4000–7000 ft.—Sterling, Logan Co.; Black Cañon of the Gunnison.

8. *Helianthus giganteus* L. In moist ground from Me. and Sask. to Fla., La. and Colo.—Mt. Harvard.

9. *Helianthus grosseserratus* Martins. On plains and prairies from N. Y. and Wyo. to Pa., Tex. and Colo.—Ft. Collins.

10. *Helianthus fascicularis* Greene. (*H. giganteus utahensis* D. C. Eaton; *H. utahensis* A. Nelson) In mountain valleys from Ass. and Alb. to Colo. and Ariz.—Alt. 5000-8000 ft.—Gunnison; Parlin, Gunnison Co.; McCoy; Cañon City; Ft. Collins; mountains, Larimer Co.; Cache la Poudre; Boulder.

51. *HELIANTHELLA* T. & G.

Chaffs of the receptacle soft and scarious.

Rays conspicuous; disk-flowers yellowish.

Disk 2-3 cm. in diameter; leaves ovate to lanceolate, thin, not strongly reticulate.

Disk less than 2 dm. wide; leaves oblanceolate to linear, strongly reticulate.

Rays few and scarcely surpassing the dark-purple disk-flowers.

4. *H. microcephala*.

3. *H. uniflora*.

Chaffs of the receptacle firm-chartaceous.

1. *Helianthella quinquenervis* A. Gray. Along mountain streams from S. D. and Ida. to Colo.—Alt. 7000-10,000 ft.—Robinson; Cerro Summit; Mt. Harvard; Moon's ranch; mountains, Larimer Co.; North Park, near Teller; Steamboat Springs; Leroux Park; Buffalo Pass; Four-mile Hill; foot of Michigan Hill; east slope of Rabbit-Ear Range; Bosworth's ranch; Mt. Abram, Ouray; Villa Grove; South Park; near Ironton, San Juan Co.; West Spanish Peak; Marshall Pass; Eldora to Baltimore; Berthoud Pass; Spicer.

2. *Helianthella Parryi* A. Gray. In the mountains of Colo., N. M. and Ariz.—Alt. 8000-10,000 ft.—Lat. 39°-41°; Veta Pass; Ruxton Dell; Artists' Glen; Green Mountain Falls; Marshall Pass.

3. *Helianthella microcephala* A. Gray. Dry plains of Southern Colo., N. M. and Utah.—Alt. 4500 ft.—San Juan Valley.

4. *Helianthella uniflora* (Nutt.) T. & G. On hills and mountains from Mont. and Ida. to N. M. and Utah.—Table Rock.

52. *XIMENESIA* Cav.

1. *Ximenesia exauriculata* (Rob. & Greenm.) Rydb. (*Verbesina encelioides exauriculata* Rob. & Greenm.) In mountain valleys from Mont. to Tex. and Ariz.—Alt. 5000-9000 ft.—Pass Creek; Cañon City; Colorado Springs; Rocky Ford; Ft. Collins; Pueblo; Mancos; Hotchkiss, Delta Co.; Huerfano Valley, near Gardner; Salida; Gunnison; Manitou; Boulder; Lafayette; Montrose; Palmer Lake; Buena Vista; Timnath.

53. *COREOPSIS* L. TICK-SEED.

Leaves once or twice pinnately divided.

Leaves simple.

1. *C. tinctoria*.

2. *C. lanceolata*.

1. *Coreopsis tinctoria* Nutt. Low ground from Man. to Va., Tex., Ariz. and Alb.—Along Platte River, near Denver.

2. *Coreopsis lanceolata* L. In rich soil from Ont. and Colo. to Fla. and La.—Ft. Collins.

54. *BIDENS* L. BEGGAR-TICKS; BUR-MARIGOLD; SPANISH NEEDLES.

Achenes flat, obovate or cuneate; leaves or segments broad.

Leaves pinnately 3-5-foliolate.

Outer bracts 4-8; achenes nearly black.

Outer bracts 10-16; achenes brown.

Leaves simple.

Heads discoid, erect; corolla 4-toothed.

Heads radiate, nodding; corolla 5-toothed.

Outer bracts not much longer than the inner; achenes not corky on the angles.

Outer bracts surpassing the rays; achenes with corky angles.

1. *B. frondosa*.

2. *B. vulgata*.

3. *B. comosa*.

4. *B. prionophylla*.

5. *B. glaucescens*.

6. *B. Bigelovii*.

7. *B. tenuisecta*.

Achenes linear, tetragonal; leaf-segments small.

Divisions of the leaves oblong or lanceolate.

Divisions of the leaves linear.

1. *Bidens frondosa* L. In wet soil from N. B. and Neb. to Fla., Tex. and Colo.—Alt. 4000-5000 ft.—Ft. Collins; Cache la Poudre.

2. *Bidens vulgata* Greene. In wet ground from Ont. and B. C. to N. C. and Calif.—Alt. 4000-5000 ft.—Ft. Collins.

3. *Bidens comosa* (A. Gray) Wiegand. (*B. connata comosa* A. Gray) In wet ground from Mass. and Nebr. to N. J. and Colo.—Along Poudre.

4. *Bidens prionophylla* Greene. In shallow water and wet ground from Ills. and Mont. to Colo.—Alt. about 5000 ft.—Poudre.

5. *Bidens glaucescens* Greene. (*B. chrysanthemoides* and *B. cernua* A. Gray, in part) In wet ground and shallow water from Sask. and Mont. to Kans. and Colo.—Alt. 4000-6000 ft.—Denver; Colorado Springs; river flats east of Ft. Collins; Poudre River; Table Rock; Tobe Miller's ranch.

6. *Bidens Bigelovii* A. Gray. Along streams from Colo. to Tex. and Ariz.—Alt. up to 7500 ft.—Manitou; Engelmann Cañon; Como; Ute Pass.

7. *Bidens tenuisecta* A. Gray. Along streams from Colo. and Ida. to Tex. and Ariz.; also in Mex.—Alt. 4000-8000 ft.—Engelmann Cañon; Colorado Springs; Buena Vista; Palmer Lake; Ute Creek; Cimarron.

55. *THELESERMA* Less.

Heads radiate.

Leaf-segments linear-filiform, 1 mm. or less wide.

Annual or biennial; outer bracts subulate-linear, more than half as long as the inner.

Perennial from a root-stock; outer bracts linear-lanceolate, half as long as the inner or less.

Leaf-segments linear, over 1 mm. wide; plant perennial.

Plant with tap-root, leafy throughout.

Plant with horizontal root-stock, leafy only at the base.

Heads discoid; perennials with root-stock or woody caudex.

1. *T. trifidum*.

2. *T. tenue*.

3. *T. intermedium*.

4. *T. subnudum*.

5. *T. gracile*.

1. *Thelesperma trifidum* (Lam.) Britton. (*T. filifolium* A. Gray) On dry plains from Neb. and Colo. to Kans., Tex. and N. M.—Alt. 4000-6000 ft.—Colorado Springs; Denver, along Platte River.

2. *Thelesperma tenue* Rydb. On plains and in mountain valleys of Colo.—Alt. 5000-9000 ft.—Veta Pass; "the plains."

3. *Thelesperma intermedium* Rydb. On plains, in dry or sandy soil, from Neb. and Wyo. to Colo.—Alt. 4000-8000 ft.—Cañon City; Wahatoya Cañon; La Veta.

4. *Thelesperma subnudum* A. Gray. On dry plains of Colo., Utah, N. M. and Ariz.—Alt. 4500-7000 ft.—Brantly Cañon, Las Animas Co.; Grand Junction; Cedar Hills; Walsenburg; dry hills about Antonito.

5. *Thelesperma gracile* A. Gray. On dry plains from Neb. and Colo. to Tex. and Ariz.—Alt. 4000-10,000 ft.—Colorado Springs; near Boulder; Manitou; New Windsor; Denver; Ft. Collins; between Sunshine and Ward; Fossil Creek; Wray; Raton Range; Poudre River.

56. *MADIA* Molina. TAR-WEED.

1. *Madia glomerata* Hook. In open dry places in the mountains from Sask. and B. C. to Colo.—Alt. 6500-9000 ft.—Valley near Empire; Rabbits-Ear Pass; Cerro Summit; Pagosa Springs; Gunnison Co.; Hubbard Creek; Dale Creek; Steamboat Springs; between Pallas and Sydney; Hotchkiss; Hayden.

Tribe 5. HELENIAE.

57. *PSILOSTROPHE* DC.

Scales of the pappus one-third as long as the disk-corollas, mostly obtuse; leaves broadly spatulate; rays 8-12 mm. long, indistinctly nerved. 1. *P. Bakeri*.

Scales of the pappus one-half as long as the disk-corollas, acute or acuminate; rays 5-8 mm. long, distinctly veined. 2. *P. tagetina*.

1. *Psilostrophe Bakeri* Greene. (*Riddellia tagetina pumila* Jones; *P. pumila* A. Nels.) On dry plains and hills in Colo. and Utah.—Alt. 5500 ft.—Uncompahgre Mountains, near Los Pinos; Rifle, Garfield Co.; Grand Junction; Delta Co.; Montrose; Hotchkiss; Palisades.

2. *Psilostrophe tagetina* (Nutt.) Greene. (*Riddellia tagetina* Nutt.) On dry plains from Colo. to Tex. and Ariz.—Sources of the Platte.

58. *PERICOME* A. Gray.

1. *Pericome caudata* A. Gray. In cañons and river valleys from Colo. to Tex. and N. M.; also in Mex.—Alt. 5000-8000 ft.—North Cheyenne Cañon; Manitou; Engelmann Cañon; Colorado Springs; Marshall Pass; Ute Pass.

59. *HYMENOPAPPUS* L'Her.

Throat of the corolla 1-1.5 mm. long, not over twice as long as the lobes.

Pappus not hidden by the hairs of the achenes.

Stem permanently densely white-tomentose; achenes silky.

1. *H. arenosus*.

Stem sparingly grayish-tomentose, glabrate in age; achenes loosely villous.

2. *H. cinereus*.

Pappus hidden by the hairs of the achenes, or sometimes none.

3. *H. filifolius*.

Throat of the corolla 3-4 times as long as the lobes.

Pappus shorter than the corolla-tube; throat of corolla 3-4 mm. long; plant tall.

4. *H. macroglottis*.

Pappus equalling the corolla-tube; throat about 1.5 mm. long; plant dwarf.

5. *H. parvulus*.

1. *Hymenopappus arenosus* Heller. On dry hills and plains from Colo. and Utah to N. M.—Alt. 5000-7000 ft.—Arboles; Dolores; hills above Trinidad; Grand Junction; Mancos; Florence.

2. *Hymenopappus cinereus* Rydb. (*H. ochroleucus* Greene) On dry hills and plains of Colo.—Alt. 5000–11,000 ft.—West of Loveland, Larimer Co.; Twin Lakes; Rifle, Garfield Co.; Cimarron; Durango; Walsenburg; mesas near Pueblo; Cucharas Valley, near La Veta; Garden of the Gods; Trinidad; Palmer Lake; across Gunnison River, Grand Junction; mountains about Manitou; Florence; Buena Vista; Colorado Springs.

3. *Hymenopappus filifolius* Nutt. On dry plains from Sask. and Mont. to Neb., Colo. and Ore.—Alt. 4000–6000 ft.—Grand Junction; Apishapa Creek, Otero Co.; foot-hills, Larimer Co.; Ft. Collins; Fossil Creek.

4. *Hymenopappus macroglottis* Rydb. On dry hills and plains from Colo. to Tex. and Ariz.—Exact locality not given; specimens collected by Fremont.

5. *Hymenopappus parvulus* Greene. On dry hills of western Colo.—Alt. about 7500 ft.—Gunnison.

60. LEUCAMPYX A. Gray.

1. *Leucampyx Newberryi* A. Gray. In cañons of Colo. and N. M.—Alt. 6000–9000 ft.—Pagosa Springs; West Indian Creek; Cimarron.

61. POLYPTERIS Nutt.

1. *Polypteris Hookeriana* (T. & G.) A. Gray. On plains from Neb. and Colo. to Tex.—Alt. 4000–6000 ft.—Golden; Ft. Collins.

62. PICRADENIOPSIS Rydb.

1. *Picradeniopsis oppositifolia* (Nutt.) Rydb. (*Bahia oppositifolia* Nutt.) In alkaline soil from S. D. and Mont. to Tex. and Ariz.—Alt. 4000–7000 ft.—Foot-hills, Colorado Springs; La Veta; New Windsor; Ft. Collins; Iola; foot-hills west of Ft. Collins; Denver; Cucharas Valley, near La Veta; Gunnison; Boulder; Rocky Ford; Pueblo; near Timnath.

63. ACHYROPAPPUS H. B. K.

1. *Achyropappus neo-mexicanus* A. Gray. (*Bahia neo-mexicana* A. Gray) In sandy soil from Colo. to N. M. and Ariz.; also Mex.—Alt. about 8000 ft.—Buena Vista; Alamosa.

64. PLATYSCHKUHRIA (A. Gray) Rydb.

Stem scapiform or nearly so; leaves firm, oval to lanceolate. 1. *P. integrifolia*.
Stem leafy; leaves thin, oblong. 2. *P. oblongifolia*.

1. *Platyschkuhria integrifolia* (A. Gray) Rydb. (*Bahia nudicaulis* A. Gray; *Schkuhria integrifolia* A. Gray) In arid regions of Wyo. and Colo.—Alt. 4000–5000 ft.—Deer Run; Grand Junction.

2. *Platyschkuhria oblongifolia* (A. Gray) Rydb. (*Bahia oblongifolia* A. Gray) In arid regions of Colo. and Utah.—Valley of San Juan.

65. BAHIA Lag.

1. *Bahia dissecta* (A. Gray) Britton. (*B. chrysanthemoides* A. Gray) Along streams from Wyo. to N. M. and Ariz.—Alt. 6000–9000 ft.—Bosworth's

ranch; Stove Prairie; Granite; Ouray; Ruxton Park; foot of Mt. Harvard; hills about Box Cañon, west of Ouray; mountains, Larimer Co.; North Cheyenne Cañon; mountains between Sunshine and Ward; Durango; Horsetooth Mountain; foot-hills, Larimer Co.; Elk Cañon; Idaho Springs; Empire; Gray's Peak; Lake City; headwaters of Clear Creek.

66. CHAENACTIS DC.

Annuals.

1. *C. stevioides*.

Perennials.

Heads corymbose, short-peduncled; caudex short, erect.

2. *C. Douglasii*.

Heads solitary, rather long-peduncled; caudex with spreading branches.

Bracts equalling the disk, only slightly tinged with purple.

3. *C. pedicularia*.

Bracts much shorter than the disk, purplish.

4. *C. alpina*.

1. *Chaenactis stevioides* H. & A. In arid places from Ida. and Nev. to N. M. and Ariz.—Alt. 4000-6000 ft.—Hotchkiss; Rifle; McElmo Cañon; Grand Junction; Delta Co.; Palisades.

2. *Chaenactis Douglasii* H. & A. In sandy and rocky places from Mont. and Wash. to Colo. and Calif.—Alt. 6000-9000 ft.—High rocks, Middle Park; North Park; Leroux, Delta Co.; Twin Lakes; Doyle's; Cimarron; headwaters of Sangre de Cristo Creek; Grand River Cañon; piñon belt, north of Mancos; Grayback mining camps and Placer Gulch; Palisades; Elk River, Routt Co.

3. *Chaenactis pedicularia* Greene. On high mountains of Colo.—Alt. about 11,500 ft.—Como; Little Kate Mine, La Plata Mountains.

4. *Chaenactis alpina* (A. Gray) Jones. (*C. Douglasii alpina* A. Gray) On high mountains from Mont. to Colo. and Utah.—"Colorado."

67. TETRANEURIS Greene.

Flowering stems scapiform, leafless.

Leaves densely appressed silky, at least when young.

Leaves not strongly 3-nerved on the broadened bases.

Leaves spatulate or oblanceolate, 2-4 cm. long; scape 2-12 cm. high.

1. *T. acaulis*.

Leaves linear or linear-oblanceolate; scape 12-20 cm. high.

2. *T. simplex*.

Leaves strongly 3-nerved on the broadened bases, narrowly oblanceolate.

3. *T. trinervata*.

Leaves loosely villous or glabrate.

Leaves, scapes and involucre decidedly long-villous.

4. *T. lanata*.

Leaves glabrous or sparingly villous; scape finely pubescent (long-villous only in *T. Torreyana*).

Branches of the caudex copiously villous at the ends, with long, at first white, but later brownish hairs.

Pappus-scales lanceolate, acute; bracts oblong.

Crowns of the caudex copiously villous; scape 5-10 cm. long.

5. *T. Torreyana*.

Crowns of the caudex not copiously villous; scape 1-2 cm. high.

6. *T. brevifolia*.

Pappus-scales oval, awned.

Leaves oblanceolate, hairy.

7. *T. arisonica*.

Leaves linear-oblanceolate, or linear-oblong, glabrate.

Bracts oval.

8. *T. pilosa*.

Bracts linear-oblong.

9. *T. Crandallii*.

Branches of the caudex not copiously villous.

Bases of the leaves not broader than the oblanceolate or almost linear blades; branches of the caudex short and stout.

Leaves oblanceolate; bracts slightly shorter than the disk; rays not strongly veined. 10. *T. glabriuscula*.

Leaves linear or oblanceolate-linear; bracts one-fourth shorter than the disk; rays strongly nerved. 11. *T. angustifolia*.

Bases of the leaves 2-4 times as wide as the linear leaf-blades; branches of the caudex elongated; bases of the leaves and involucre sparingly silky villous. 12. *T. stenophylla*.

Stems 2-3 dm. high with 2-4 leaves.

Outer bracts oval or ovate, purple. 13. *T. leptoclada*.

Outer bracts linear-oblong or lanceolate, green. 14. *T. intermedia*.

1. *Tetranneuris acaulis* (Pursh) Greene. (*Actinella acaulis* Nutt.) On hills and dry plains from Neb., Mont. and Ida. to N. M.—Alt. 4000-6000 ft.—Rocky Ford, Otero Co.; Bartlett; mesas near Pueblo; Trinidad; Colorado City.

2. *Tetranneuris simplex* A. Nelson. On dry hills from S. D. and Ida. to Neb. and Colo.—Crow Creek; Monument.

3. *Tetranneuris trinervata* Greene. On dry hills from Colo. to Tex.—On the Platte.

4. *Tetranneuris lanata* (Nutt.) Greene. (*Actinella lanata* Nutt.) On the mountains of Wyo. and Colo.—Alt. 6000-13,000 ft.—Mountain near Veta Pass; Seven Lakes; Como; West Indian Creek; west slope of Bald Mountain; Pike's Peak; Central City; Mt. Garfield; mesas near Colorado Springs; Berthoud Pass; Sangre de Cristo Pass; north of La Porte; Pine Grove; James' Peak.

5. *Tetranneuris Torreyana* (Nutt.) Greene. (*A. Torreyana* Nutt.) On rocky hills of Wyo., Colo. and Utah.—Alt. 4000-6500 ft.—Near northern State line.

6. *Tetranneuris brevifolia* Greene. Exposed mountains near Pike's Peak, Colo.

7. *Tetranneuris arizonica* Greene. On dry hills from Colo. to Ariz.—Trinidad; Colorado Springs.

8. *Tetranneuris pilosa* Greene. On dry hills and mountains from Colo. to Ariz.—Alt. about 7000 ft.—Los Pinos (Bayfield); Manitou.

9. *Tetranneuris Crandallii* Rydb. On dry hills of Colo.—Alt. 4000-5000 ft.—Grand Junction; McCoy's, Eagle Co.; Cimarron.

10. *Tetranneuris glabriuscula* Rydb. (*T. glabra* Greene; not *Actinella glabra* Nutt.) On dry hills from Colo. and Nev. to N. M.—Alt. about 6000 ft.—Ft. Collins; Cañon City; Red Rock Cañon, near Pike's Peak.

11. *Tetranneuris angustifolia* Rydb. On dry rocky hills from Colo. to Tex. and N. M.—Alt. up to 7000 ft.—Table Rock; Mancos; Ft. Lyon; Arkansas River.

12. *Tetranneuris stenophylla* Rydb. On dry plains from Kans. and Colo. to Tex.; also Mex.—Banks of Cimarron.

13. *Tetranneuris leptoclada* (A. Gray) Greene. (*Actinella leptoclada* A. Gray; *T. Mancosensis* A. Nels.) On dry hills of Colo. and N. M.—Alt. up to 9000 ft.—Mancos; Leroux Creek, Delta Co.

14. *Tetranneuris intermedia* Greene. On dry hills of southern Colo.—Alt. 6500-7000 ft.—Cimarron; Pagosa Springs.

68. CHAMAECHAENACTIS Rydb.

1. *Chamaechaenactis scaposa* (Eastw.) Rydb. (*Chaenactis scaposa* Eastw.)
In arid regions of Utah and Colo.—Grand Junction.

69. RYDBERGIA Greene.

Involucres densely white-woolly at the base; basal leaves more or less doubly pinnatifid.

Involucres darker, short-villous at the base; leaves simply pinnatifid with few divisions.

1. *R. grandiflora*.2. *R. Brandegei*.

1. *Rydbergia grandiflora* (T. & G.) Greene. (*Actinella grandiflora* T. & G.)
On high mountain sides from Mont. to N. M. and Calif.—Alt. 9000–13,500 ft.—Alpine Tunnel; Pike's Peak; Iron-ton, San Juan Co.; Gray's Peak; Mt. Harvard; Mt. Abram, Ouray; Seven Lakes; mountains south of Ward, Boulder Co.; Little Kate Mine, La Plata Mountains; near Pagosa Peak; Floral Mountain, near Georgetown; mountains above Como; Carson; Cameron Pass; Berthoud Pass; Beaver Creek; mountain northwest of Como; mountains about Graymont; Massif de l'Arapahoe; Hinsdale Co.; headwaters of Clear Creek; Ethel Peak.

2. *Rydbergia Brandegei* (A. Gray) Rydb. (*Actinella Brandegei* A. Gray; *Rydbergia glabrata* Greene) On high peaks of southern Colo. and N. M.—Alt. 9000–13,000 ft.—West Spanish Peak; Sierra Blanca.

70. HYMENOXYS Cass. COLORADO RUBBER PLANT.

Plant low, perennial with a multicapal caudex.

Heads mostly solitary at the ends of the branches.

Rays 12–18 mm. long; plant 1–3 dm. high.

Rays 5–8 mm. long; plant less than 1 dm. high.

1. *H. macrantha*.2. *H. pumila*.

Heads mostly corymbose.

Rays orange, broadly cuneate.

3. *H. Earlei*.

Rays yellow, oblong or somewhat cuneate.

4. *H. floribunda*.

Plant tall, 3 dm. high or more, biennial or short-lived perennial, with one or few stems from a tap-root.

Stem simple below; leaves pinnate or simple; disk over 1 cm. wide.

5. *H. helenioides*.

Stem diffusely branched; leaves once to thrice ternate; disk 5–8 mm. wide.

6. *H. multiflora*.

1. *Hymenoxys macrantha* (A. Nels.) Rydb. (*Picradenia macrantha* A. Nels.; *H. Richardsonii macrantha* Cockerell) In dry soil from Wyo. to Utah and Colo.—Como; South Park.

2. *Hymenoxys pumila* (Greene) Rydb. (*Picradenia pumila* Greene; *H. Richardsonii pumila* Cockerell) Very dry hills from Ass. to Colo. and Utah.—North Park.

3. *Hymenoxys Earlei* Cockerell. In the piñon belt of Colo.—Mancos.

4. *Hymenoxys floribunda* (A. Gray) Cockerell. (*Actinella Richardsonii floribunda* A. Gray; *Picradenia floribunda* Greene) In dry or gravelly soil from Colo. to N. M. and Ariz.—Alt. 4000–10,000 ft.—Como; Buena Vista; Marshall Pass; Placer; Westcliffe; Twin Lakes; Mancos; Gunnison; Sangre de Cristo Creek; Turkey Creek and tributaries; Mt. Harvard; dry plains south of Antonito; Dillon Cañon; Nepesta; Colorado Springs.

5. *Hymenoxys helenioides* (Rydb.) Cockerell. (*Picradenia helenioides* Rydb.) In river valleys of southern Colo.—Alt. 8000-9000 ft.—Sangre de Cristo Creek.

6. *Hymenoxys multiflora* (Buckley) Rydb. (*Phileosera multiflora* Buckley; *Picradenia multiflora* Greene) Dry plains from Kans. and Colo. to Tex. and Ariz.; also northern Mex. In Colorado represented by var. *Osterhoutii* (Cockerell) Rydb. (*H. chrysanthemoides Osterhoutii* Cockerell).—Apishapa Creek, Otero Co.

71. FLAVERIA Juss.

1. *Flaveria angustifolia* (Cav.) Pers. In alkaline soil from Colo. to Tex. and N. M.; also Mex.—Alt. about 4600 ft.—Grand Junction.

72. DUGALDIA Cass.

1. *Dugaldia Hoopesii* (A. Gray) Rydb. (*Helenium Hoopesii* A. Gray) In mountain valleys from Wyo. to N. M. and Calif.—Alt. 7000-12,000 ft.—Mountains above Ouray; Crested Butte; Leroux Creek; Red Mountain; Breckenridge; Veta Pass; Westcliffe; Ironton Park, nine miles south of Ouray; Sangre de Cristo Creek; Grayback mining camps; Ironton, San Juan Co.; along carriage road to Pike's Peak; near Pagosa Peak; Trappers' Lake; Cripple Creek; La Plata Cañon; Gore Pass; Mancos; Leroux Creek delta; Hahn's Peak; Lake City.

73. HELENIUM L. SNEEZE-WEED.

1. *Helenium montanum* Nutt. (*H. autumnale* A. Gray, in part; not L.) In meadows from Minn., Sask. and Wash. to Miss. and Colo.—Kremmling.

74. GAILLARDIA Foug.

Lobes of the disk-corollas acute.

1. *G. aristata*.

Lobes of the disk-corollas short and broad, obtuse.

2. *G. pinnatifida*.

1. *Gaillardia aristata* Pursh. On hills and plains from Sask. and B. C. to Colo. and Ore.—Alt. 4000-8000 ft.—Glenwood Springs; Larimer Co.; Horsetooth Gulch; Rist Cañon; Westcliffe; Veta Pass; Idaho Springs; foot-hills west of Ft. Collins; Empire; Boulder; Soldier Cañon; Monument; hill north-west of Soldier Cañon; Spring Cañon; Redstone; forks of the Poudre and Big South; Dixon Cañon; Stove Prairie Hill; Narrows; Table Rock.

2. *Gaillardia pinnatifida* Torr. On dry plains from Colo. to Tex. and Ariz.—Alt. 4000-6000 ft.—Deer Run; Durango; Walsenburg; Grand Junction.

75. BOEBERA Willd. FETID MARIGOLD.

1. *Boebers papposa* (Vent.) Rydb. (*Dysodia chrysanthemoides* Lag.) On prairies, river valleys, roadsides and waste places from Ohio and Mont. to Ark. and Ariz.; also Mex.—Alt. 4000-7000 ft.—Cucharas Valley, near La Veta; Ft. Collins; Minnehaha; Boulder; Lyons; Colorado Springs; North Cheyenne Cañon.

76. LOWELLIA A. Gray.

1. *Lowellia aurea* A. Gray. (*Hymenatherum aureum* A. Gray) On plains from Colo. to Texas.—Rocky Ford, Otero Co.; Cañon City; Pueblo; Huerfano; Colorado Springs; Denver.

77. PECTIS L.

1. *Pectis angustifolia* Torr. In "sand-draws" and on sandy hillsides from Neb. and Colo. to Tex. and Ariz.—Alt. 4000–11,000 ft.—Pueblo; Rocky Ford; Little Veta Mountain; Cañon City.

Tribe 6. ANTHEMIDEAE.

78. ANTHEMIS L. MAY-WEED, FETID CAMOMILE.

1. *Anthemis Cotula* L. In fields and waste places from Newf. and Yukon to Fla. and Calif.—Alt. about 5000 ft.—Ft. Collins; Hotchkiss.

79. ACHILLEA L. YARROW.

Bracts with light brownish margins.

1. *A. lanulosa*.

Bracts with dark brown, nearly black margins.

2. *A. alpicola*.

1. *Achillea lanulosa* Nutt. On plains and mountains from western Ont. and Yukon to Ind. Terr. and Calif.; also Mex.—Alt. 4000–12,000 ft.—Ft. Collins; Arboles; Sangre de Cristo Creek; Cucharas River, below La Veta; Iron-ton Park, nine miles south of Ouray; along Uncompahgre River, near Ouray; Dark Cañon; Ruxton Brook; Seven Lakes; Gunnison; Cerro Summit; mountains between Sunshine and Ward; Raton Range; Dillon Cañon, Trinidad; Pike's Peak; Steamboat Springs.

2. *Achillea alpicola* Rydb. (*A. lanulosa alpicola* Rydb.) On high mountains from Mont. to Colo.—Alt. 11,000–12,000 ft.—Little Kate Mine, La Plata Mountains; Seven Lakes; Mt. Ouray.

80. CHRYSANTHEMUM L. OX-EYE DAISY.

1. *Chrysanthemum Leucanthemum* L. Naturalized from Europe from Lab. to Fla., Colo. and Mont.—Along Platte River, near Denver.

81. Picrothamnus Nutt.

1. *Picrothamnus desertorum* Nutt. (*Artemisia spinescens* D. C. Eaton) On arid hills from Mont. and Ida. to N. M. and Calif.—Alt. 4000–6000 ft.—Palisades, Mesa Co.; Hotchkiss; Grand River Cañon, above Palisades; Delta Co.

82. ARTEMISIA L. WORMWOOD, SAGE-BRUSH.

Heads heterogamous, i. e., flowers unlike; disk-flowers hermaphrodite; marginal ones pistillate, truncate, 2–3-toothed.

Disk-flowers sterile; their styles mostly entire, penicillate; ovary abortive.

I. DRACUNCULOIDES.

Disk-flowers fertile; their styles two-cleft.

Receptacle with long villous hairs.

II. FRIGIDAE.

Receptacle glabrous.

Annuals or biennials, tall.

III. ANNUE.

Perennials.

Plants not shrubby, except at the base; leaves not cuneate with 3-toothed apex.

Plant not at all tomentose; plant low, 1–3 dm. high.

IV. ARCTICAE.

Plant more or less tomentose, at least on the lower surface of the leaves.

Involucres densely tomentose.

Leaves all entire or the lower merely toothed.

V. GNAPHALOIDES.

Leaves at least the lower ones pinnately divided or lobed.

Divisions of the leaves not narrowly linear or filiform; margins scarcely revolute.

VI. DIVERSIFOLIAE.

Divisions of the leaves narrowly linear to filiform; margins revolute.

VII. STENOPHYLLAE.

Involucres in age glabrous, only slightly tomentose when young.

VIII. VULGARES.

Plant shrubby; leaves cuneate, 3-toothed at the apex.

IX. BIGELOVIANAE.

Heads homogamous; i. e., flowers all alike, hermaphrodite and fertile; plants shrubby.

X. TRIDENTATAE.

I. DRACUNCULOIDES.

Plants frutescent only at the base; heads rather many-flowered, hemispherical, over 1.5 mm. in diameter.

Plants glabrous, at least in age; leaves all, except the lower ones, simple and linear.

Leaves and bracts dark green; heads 3-4 mm. wide; flowers 30-40, brown.

1. *A. aromatica*.

Leaves and bracts lighter; heads 2-3.5 mm. wide; flowers yellow or light brown, about 20.

2. *A. dracunculoides*.

Plant pubescent; leaves nearly all pinnatifid.

Heads 2-3 mm. wide; bracts glabrous; stem appressed-hairy or glabrate; flowers yellow.

Stem-leaves with 1-2 pairs of lateral divisions close at the base, or entire grayish canescent.

3. *A. glauca*.

Stem-leaves pinnatifid or bipinnatifid with distant divisions, mostly green at least in age.

Stem tall, 5-10 dm. high, very leafy, in age nearly glabrous; divisions of the leaves linear-filiform.

4. *A. Scouleriana*.

Stem lower, 2-6 dm. high; divisions of the basal leaves linear-oblancoate, more or less canescent.

5. *A. Forwoodii*.

Heads 4-5 mm. wide; bracts and stem at least when young with long silky-villous loose hairs; flowers brown.

6. *A. spithamea*.

Plant shrubby; heads few-flowered, 1-1.5 mm. in diameter; divisions of the leaves filiform.

7. *A. filifolia*.

II. FRIGIDAE.

Heads numerous, 4-5 mm. wide; bracts light brown; plants usually comparatively tall, 3-8 dm. high.

8. *A. frigida*.

Heads few, 6-12 mm. in diameter; bracts with dark brown or blackish margins; plant low, 1-2 dm. high.

Heads several, spicately or racemosely disposed; corolla pubescent; basal leaves and lower stem-leaves bipinnatifid.

9. *A. scopulorum*.

Heads solitary or 2-4 in a close cluster; corolla glabrous or nearly so; basal leaves pinnatifid with short divisions.

10. *A. Pattersonii*.

III. ANNUAE.

One species.

11. *A. biennis*.

IV. ARCTICAE.

Plant pubescent.

12. *A. saxicola*.

Plant glabrous.

13. *A. Parryi*.

V. GNAPHALOIDES.

Leaves in age glabrate above.

14. *A. silvicola*.

Leaves permanently tomentose on both sides.

Heads erect, peduncled, 4-5 mm. wide; flowers brown.

Heads nodding or spreading, 4 mm. or less wide.

15. *A. natronensis*.

Heads distinctly pedicelled, nodding, on lax racemiform branches.

16. *A. pudica*.

Heads subsessile, conglomerate on short branches.

Heads 3-4 mm. wide; flowers dark or purplish brown.

17. *A. rhizomata*.

Heads 2-3 mm. wide; flowers light brown.

Leaves lanceolate.

18. *A. gnaphaloides*.

Leaves linear or nearly so.

19. *A. pabularis*.

VI. DIVERSIFOLIAE.

Leaves in age greenish and more or less glabrate above.

Lower leaves more or less cuneate-ob lanceolate, lobed above the middle with lanceolate lobes; upper leaves entire; plant usually cespitose.

20. *A. ludoviciana*.

Leaves nearly all deeply pinnatifid, with linear or linear-lanceolate lobes.

21. *A. Underwoodii*.

Leaves permanently and almost equally white-tomentose on both sides.

Lower leaves cuneate or cuneate-ob lanceolate, 3-lobed (more seldom 5-lobed) above the middle with lanceolate lobes.

22. *A. Brittonii*.

Lower leaves deeply pinnatifid with long linear or linear-lanceolate lobes.

23. *A. diversifolia*.

VII. STENOPHYLLAE.

Leaves in age glabrate above; inflorescence lax.

Heads erect; divisions of the leaves filiform.

24. *A. Wrightii*.

Heads nodding; divisions of the leaves narrowly linear.

25. *A. Bakeri*.

Leaves permanently white-tomentose on both sides; heads crowded.

Leaves, at least the lower ones, with linear rather short divisions.

26. *A. coloradensis*.

Leaves with filiform divisions.

27. *A. kansana*.

VIII. VULGARES.

Divisions of the leaves broad, lanceolate or oblong.

Leaves, except the uppermost, twice pinnatifid with obtusish lobes, glabrous or minutely appressed canescent beneath.

28. *A. fraserioides*.

Leaves, except sometimes the lowermost, once pinnatifid, with acute or acutish lobes, or the upper entire, white-tomentose beneath.

Tall, 6-10 dm. high; upper leaves entire; the rest simply pinnatifid.

29. *A. elatior*.

Lower, 2-6 dm. high; all leaves pinnatifid; the lower often twice pinnatifid.

30. *A. incompta*.

Divisions of the leaves narrowly linear-lanceolate or linear.

31. *A. discolor*.

IX. BIGELOVIANAE.

One species.

32. *A. Bigelovii*.

X. TRIDENTATAE.

Leaves nearly all trifid or tridentate at the apex.

Divisions of the leaves mostly long, narrowly linear, sometimes almost filiform; heads about 2 mm. wide.

33. *A. tripartita*.

Divisions or teeth of the leaves short, ovate or oblong.

Heads 2-3 mm. wide.

Bracts densely tomentose; inflorescence rather congested.

Shrub tall; inflorescence much branched; heads about 2 mm. wide.

34. *A. tridentata*.

Shrub dwarf; inflorescence rather simple and spike-like; heads 3 mm. wide.

35. *A. arbuscula*.

Bracts of the involucre almost glabrous; inflorescence lax, racemiform.

36. *A. nova*.

Heads about 5 mm. wide; outer bracts only tomentose; inflorescence raceme-
or spike-like.

Leaves all linear, entire, acute, or rarely a few of them 3-cleft at the apex;
heads 3-4 mm. wide in a compact inflorescence.

Leaves permanently canescent, not viscid.

Leaves, at least in age, glabrate, more or less viscid.

37. *A. spiciformis*.

38. *A. cana*.

39. *A. viscidula*.

1. *Artemisia aromatica* A. Nels. In mountain valleys from Alb. and Wash.
to Colo.—Alt. up to 9000 ft.—Breckenridge; Iron-ton Park, nine miles south
of Ouray.

2. *Artemisia dracunculoides* Pursh. On prairies and plains from Mont. and
Ida. to Tex. and Calif.—Alt. 5000-8000 ft.—Below Hot Sulphur Springs;
Middle Park; Ft. Collins; Iola; Huerfano Valley, near Gardner; Table Rock;
Elk River; Democrat Mountain.

Artemisia dracunculoides Wolfii Rydb. Heads larger with lanceolate bracts.
In mountain valleys of Wyo. and Colo.—Alt. 7000-9000 ft.—Hamor's Lake,
north of Durango; Grizzly Creek; Honnold; Twin Lakes; Colorado Springs.

3. *Artemisia glauca* Pall. On plains from Man. and Ass. to Nebr. and
Colo.—Golden.

4. *Artemisia Scouleriana* (Besser) Rydb. (*A. desertorum Scouleriana*
Besser) In valleys from B. C. to Colo.—Alt. 5000-10,000 ft.—New Windsor;
Ruxton Dell; Denver.

5. *Artemisia Forwoodii* S. Wats. (*A. desertorum* Besser, in part; *A. Cana-*
densis A. Gray, in part; not Michx.) On plains and hills from Ass. and
Mont. to N. M.—Alt. 5000-7500 ft.—Iola; Mt. Harvard; Baxter's ranch;
Redstone; foot-hills, Larimer Co.; Boulder; Pine Grove; Ft. Collins; Cipango
Hill; Lake City; Cheyenne Mountain; South Park.

6. *Artemisia spithamea* Pursh. (*A. borealis* A. Gray, in part; not Pall)
On alpine peaks and in arctic regions from Lab. to Alaska and Colo.—Alt.
11,000-12,500 ft.—Cameron Pass; Gray's Peak; mountains about the head-
waters of Clear Creek; Cumberland Mine, La Plata Mountains; Berthoud
Pass; near Empire.

7. *Artemisia filifolia* Torr. On plains from Neb. and Wyo. to Tex. and
Ariz.; also Mex.—Alt. 4000-5500 ft.—Cheyenne Wells; New Windsor; near
Denver; near Timnath; plains of the Platte.

8. *Artemisia frigida* Willd. On dry hills from Hudson Bay to Alaska, Tex.
and Utah.—Alt. 4000-10,000 ft.—Chambers' Lake; Pagosa Springs; Boulder;
Graymont; Bosworth's ranch, Stove Prairie; Iola; Mt. Harvard; Cucharas
Valley, near La Veta; Denver; Colorado Springs; mountains of Larimer Co.;
dry hills, Lake John, North Park; Manitou; Gunnison; Twin Lakes; Middle
Park; Ft. Collins; Golden; Lake City.

9. *Artemisia scopulorum* A. Gray. On high mountain peaks from Wyo. to
Colo. and Utah.—Alt. 11,000-14,000 ft.—Near Iron-ton, San Juan Co.; head-
waters of Clear Creek; Pike's Peak; Seven Lakes; Gray's Peak; Cumberland
Mines, La Plata Mountains; mountains above Como; mountains south of
Ward; Mt. Garfield; Alpine Tunnel; Franklin; Beaver Creek; Boreas.

10. *Artemisia Pattersonii* A. Gray. On alpine peaks of Colo.—Alt. 11,000-
13,500 ft.—Summit of Mt. Garfield; west slope of Bald Mountain; Bottomless
Pit; Seven Lakes; Saddle, Pike's Peak; Gray's Peak.

11. *Artemisia biennis* Willd. In wet places from N. S. to Mackenzie,

Pa. and Calif.—Alt. 5000-9000 ft.—Honnold; Higho; Ft. Collins; Cucharas Valley, near La Veta; Middle Park; Poudre River.

12. *Artemisia saxicola* Rydb. (*A. Chamissoniana saxatilis* Besser; *A. Norvegica* A. Gray; not Fries) On the higher rockies of Colo. and Wyo.—Alt. 11,000-13,000 ft.—Gray's Peak; Silver Plume; Long's Peak; Cameron Pass; Mt. Harvard; Berthoud Pass; headwaters of Clear Creek; Empire; Ethel Peak.

13. *Artemisia Parryi* A. Gray. On alpine peaks of Colo.—Sangre de Cristo Pass.

14. *Artemisia silvicola* Osterh. In the mountains of Colo. and N. M.—Alt. about 8000 ft.—McIntyre Creek, Larimer Co.; near Pagosa Peak.

15. *Artemisia natronensis* A. Nels. In valleys of Wyo. and Colo.—Alt. 7000 ft.—Cucharas Valley, near La Veta.

16. *Artemisia pudica* Rydb. On dry ground in the mountains of Colo.—Alt. about 7700 ft.—Gunnison.

17. *Artemisia rhizomata* A. Nels. In valleys from Alb. and Ida. to Colo.—Alt. 8000-10,000 ft.—Ruxton Park; Ruxton Dell; Columbine; Pitkin; Bosworth's ranch, Stove Prairie.

18. *Artemisia gnaphaloides* Nutt. On prairies and river banks from N. D. and Wyo. to Ark. and Colo.; also introduced eastward to Ont. and N. Y.—Alt. 4000-9000 ft.—Gunnison; on Grizzly Creek; Trail Glen; Ft. Collins; Bosworth's ranch, Stove Prairie; above Poudre; Middle Park; Denver; New Windsor; Larimer Co.; Colorado Springs.

19. *Artemisia pabularis* (A. Nels.) Rydb. (*A. rhizomata pabularis* A. Nels.) In dry valleys from Neb. and Wyo. to Colo.

20. *Artemisia ludoviciana* Nutt. On prairies and in cañons from Mo. and Wyo. to Tex. and Ariz.—Alt. 4000-8000 ft.—Idaho Springs; Engelmann Cañon; Manitou; between Porter and Durango; near Empire.

21. *Artemisia Underwoodii* Rydb. On chaparral-covered hills and mountain sides in Colo.—Alt. 7500-9000 ft.—Ouray; Georgetown.

22. *Artemisia Brittonii* Rydb. Dry hills and plains of Colo. and Utah.—Alt. 5000-9000 ft.—Boulder; Empire; Golden; Poudre River flats.

23. *Artemisia diversifolia* Rydb. In valleys from Ida. and B. C. to Colo. and Wash.—Pike's Peak.

24. *Artemisia Wrightii* A. Gray. On dry plains of Colo. and N. M.—Southern Colorado; exact locality not given.

25. *Artemisia Bakeri* Greene. On dry plains and in cañons from Colo. to N. M. and Ariz.—Alt. up to 7000 ft.—Black Cañon; between Porter and Durango.

26. *Artemisia coloradensis* Osterh. In mountain valleys from Colo. to Ariz.—Alt. 7000-10,000 ft.—Dale Creek, Larimer Co.; Marshall Pass; Pine Grove; Rustic; Soldier Cañon; San Luis Valley; Lake City.

27. *Artemisia kansana* Britton. (*A. stenoloba* Rydb.) On dry plains from Kans. and Colo. to N. M.—Alt. 4000-7000 ft.—Cucharas Valley, near La Veta.

28. *Artemisia fraserioides* Greene. In the mountains from Colo. to N. M. and Mex.—Alt. about 9000 ft.—Near Pagosa Peak; Roubadeaux Pass; Lake City.

29. *Artemisia elatior* (T. & G.) Rydb. In mountain valleys from Macken-

zie and Alaska to Colo.—Alt. about 8000 ft.—Red Mountain, south of Ouray.

30. *Artemisia incompta* Nutt. Hillsides from Mont. to northern Colo.—Anita Peak.

31. *Artemisia discolor* Dougl. In the mountains from Alb. and B. C. to Colo., Utah and Wash.—Lake City.

32. *Artemisia Bigelovii* A. Gray. On dry plains from Colo. to Tex. and Ariz.—Arkansas River.

33. *Artemisia tripartita* Rydb. (*A. trihda* Nutt.) On plains and hills from Mont. and Wash. to Colo. and Ore.—Exact locality not given.

34. *Artemisia tridentata* Nutt. On dry plains (sage plains) from Neb., Mont. and B. C. to Colo. and Calif.—Alt. 4000-9500 ft.—Grand River, Sheeps-horn road; Grand River, near State Bridge; Montrose; Pitkin; Gunnison; Steamboat Springs; near Empire; Upper Laramie River; Cimarron; Durango; Sangre de Cristo Creek; Hotchkiss; Breckenridge.

35. *Artemisia arbuscula* Nutt. On dry mountains and high plains from Wyo. and Ore. to Colo. and Calif.—Hayden flats, Routt Co.

36. *Artemisia nova* A. Nels. On high plains of Colo. and Wyo.—Alt. about 7700 ft.—Gunnison.

37. *Artemisia spiciformis* Osterh. On dry plains of Colo. and Utah.—Alt. about 9000 ft.—West side of North Park; Crested Butte.

38. *Artemisia cana* Pursh. On dry plains and hills from Sask. and Mont. to Colo.—Alt. 4000-10,000 ft.—Breckenridge; Marshall Pass; west of Hebron; Hayden flats, Routt Co.; Timnath.

39. *Artemisia viscidula* (Osterh.) Rydb. (*A. cana viscidula* Osterh.) On dry plains of Wyo. and Colo.—Steamboat Springs.

Tribe 7. SENECTIONEAE.

83. PETASITES Tourn. SWEET COLTSFOOT.

1. *Petasites sagittata* (Pursh) A. Gray. In wet ground from Lab. and Alaska to Minn. and Colo.—Alt. 8000-10,000 ft.—Eldora to Baltimore; Georgetown.

84. HAPLOESTES A. Gray.

1. *Haploestes Greggii* A. Gray. On dry plains from Kans. and Colo. to Tex. and N. M.—Southeastern Colorado; exact locality not given.

85. ARNICA L.

Heads radiate.

Basal leaves and lower stem-leaves with cordate or broadly ovate blades and slender petioles.

Achenes glabrous or glandular puberulent; rarely with a few silky hairs above.

1. *A. platyphylla*.

Achenes densely hirsute or strigose.

Blades of the leaves broadly oval; the basal ones with short petioles.

2. *A. silvatica*.

Basal and lower stem-leaves with long petioles and usually cordate bases; involucre and peduncles more or less villous, slightly glandular.

Plant 1-2 dm. high; leaves thick, usually entire.

3. *A. pumila*.

Plant 2-4 dm. high; leaves thin, usually toothed.

4. *A. cordifolia*.

Basal leaves with spatulate, oblanceolate or lanceolate blades.

Stem leafy and usually with several heads; stem-leaves not much reduced. Leaves grayish, densely villous or tomentulose.

Pubescence of the leaves soft and villous.

Leaves broadly oblanceolate or lanceolate.

Leaves linear or linear-lanceolate.

Pubescence of the leaves very short and fine; leaves linear-lanceolate.

5. *A. rhizomata*.

6. *A. foliosa*.

7. *A. celsa*.

Leaves green, not densely pubescent.

Plant sparingly hirsute or glabrate; leaves usually broad.

Involucres and peduncles pilose or villous, not at all glandular or viscid.

Stem tall, 4-6 dm. high; involucres hemispherical.

8. *A. macilenta*.

9. *A. Rydbergii*.

Stem low, 1.5-3 dm. high, few-leaved; involucre turbinate or campanulate.

Involucres and peduncles hirsute and glandular.

Bracts oblanceolate.

11. *A. coloradensis*.

Bracts linear-lanceolate

12. *A. subplumosa*.

Plant minutely glandular puberulent; leaves linear-lanceolate.

13. *A. longifolia*.

Stem with a few more or less reduced leaves and usually a single head.

Basal leaves not with a tuft of brown hairs at the bases.

Involucres turbinate, as well as the peduncles densely villous, scarcely at all glandular; stem glabrous or nearly so below.

Leaves strongly 3-nerved.

9. *A. Rydbergii*.

Leaves faintly 3-nerved.

10. *A. tenuis*.

Involucres hemispherical, as well as the peduncles more or less glandular; stem pubescent throughout.

Involucres densely hirsute and glandular.

Stem-leaves linear.

14. *A. fulgens*.

Stem-leaves ovate-lanceolate.

11. *A. coloradensis*.

Involucres glandular-puberulent.

7. *A. celsa*.

Basal leaves with a dense tuft of brown hairs at their bases.

Leaves linear.

15. *A. pedunculata*.

Leaves oblong, lanceolate or oblanceolate.

16. *A. monocephala*.

Heads discoid.

17. *A. Parryi*.

1. *Arnica platyphylla* A. Nels. In the mountains of Mont. and Ida. to Colo.—Ragged Mountain.

2. *Arnica silvatica* Greene. On wooded mountains from Mont. to Colo.—Alt. 9000-12,000 ft.—Ruby; Mt. Bartlett; Robinson.

3. *Arnica pumila* Rydb. (*A. parvifolia* Greene) On the mountains from Wyo. to Colo. and Utah.—Alt. 8000-11,000 ft.—Westcliffe; hills about Box Cañon, west of Ouray; Red Mountain, south of Ouray; Veta Pass; Valley Spur; Mt. Hesperus; Marshall Pass; Gray's Peak.

4. *Arnica cordifolia* Hook. On wooded hills from Mont. and B. C. to Colo. and Calif.—Alt. 6000-11,000 ft.—Rist Cañon; mountains about Ouray; foot-hills, Larimer Co.; Bear Creek divide, west of Mt. Hesperus; Silver Plume; near Pagosa Peak; Wahatoya Cañon; mountain near Veta Pass; East Indian Creek; Chambers' Lake; foot-hills west of Ft. Collins; Silverton; Lake Moraine; Cañon City; Tennessee Pass, Lake Co.; Carson; Villa Grove; Eldora to Baltimore; Berthoud Pass; between Sunshine and Ward; Stove Prairie Hill; Horsetooth Gulch; Long Gulch; Clear Creek Cañon; Massif de l'Arapahoe; near Denver; Lake City.

5. *Arnica rhizomata* A. Nels. (*A. lanulosa* Greene) In valleys from Mont. and Ida. to Colo.—Alt. 8000-11,000 ft.—Banks of Elk River, Routt Co.; on Grizzly Creek; Marshall Pass; Robinson; below Grand Lake; Twin Lakes; Crested Butte.

6. *Arnica foliosa* Nutt. In valleys from Mont. to Colo.—Alt. 8000–10,000 ft.—Silverton; alkali meadow, Higho; Sargent; Parlin.
7. *Arnica celsa* A. Nels. In valleys from Wyo. to Colo.—Estes Park, Larimer Co.; Iola; Grizzly Creek.
8. *Arnica macilentia* Greene. In valleys of Wyo. and Colo.—Alt. about 8000 ft.—Steamboat Springs; Andrews' Shetland ranch.
9. *Arnica Rydbergii* Greene. On hills from Mont. to Colo.—Alt. 8000–12,000 ft.—Lula Pass, Larimer Co.; Silver Plume; Cameron Pass; Eldora to Baltimore; Hahn's Peak; summit of North Park Range.
10. *Arnica tenuis* Rydb. In the mountains of Colo. and Wyo.—Alt. 9000–12,000 ft.—Beaver Creek.
11. *Arnica coloradensis* Rydb. In the mountains of Colo.—Exact locality not given.
12. *Arnica subplumosa* Greene. (*A. Chamissonis longinodosa* A. Nels.) In meadows from Mont. to Colo.—Alt. 10,000–12,000 ft.—Mountains above Ouray; Marshall Pass; mountains east of North Park; Silver Plume; Breckenridge; Mt. Harvard; Berthoud Pass; Buffalo Pass; Chambers' Lake; Gray's Peak; Fish Creek Falls.
13. *Arnica longifolia* D. C. Eaton. (*A. polycephala* A. Nels.) In meadows from Mont. and Wash. to Colo. and Calif.—Alt. 10,000 ft.—Keblar Pass; Ethel Peak.
14. *Arnica fulgens* Pursh. On hills from S. D., Alb. and B. C. to Colo. and Calif.—Alt. 8500 ft.—Empire; Pinkham Creek.
15. *Arnica pedunculata* Rydb. On hills from N. D. and Wash. to Colo. and Calif.—Alt. 6000–10,000 ft.—Vicinity of Como; Clear Creek; Estes Park; Horsetooth Gulch; foot-hills, Larimer Co.; gulch south of Boulder; Table Rock; Dixon Cañon; Rist Cañon.
16. *Arnica monocephala* Rydb. On hills from Mont. and Ida. to Colo.—Alt. 6000–12,000 ft.—Dale Creek, Larimer Co.; Horsetooth Mountain; Berthoud Pass.
17. *Arnica Parryi* A. Gray. (*A. eradiata* (A. Gray) Heller) In the mountains from Mont. and B. C. to Colo. and Wash.—Alt. 9000–13,500 ft.—Gore Pass; sources of Leroux Creek; continental divide, Routt Co.; Little Kate Mine, La Plata Mountains; Cameron Pass; Mt. Harvard; Silverton; Silver Plume; Rogers; Buffalo Pass; Berthoud Pass; Caribou; headwaters of Clear Creek; Rabbit Ears, Larimer Co.; Hahn's Peak.

86. *SENECIO* L.

Heads more or less nodding.

Heads discoid.

Heads radiate.

Heads not nodding.

Heads over 15 mm. high and 20 mm. broad, solitary (seldom 2–3).

Heads less than 15 mm. high and broad.

Plants equally leafy throughout.

Leaves or their divisions not narrowly linear or filiform.

Leaves merely toothed and entire, not pinnatifid.

Leaf-blades oval, elliptic or obovate, usually obtusish; heads few.

Leaf-blades triangular or ovate to linear-lanceolate, distinctly acute; heads usually many.

I. PUDICI.

II. AMPLECTENTES.

II. AMPLECTENTES.

III. OCCIDENTALES.

Leaf-blades at least the lower ones triangular or cordate.

IV. TRIANGULARES.

Leaf-blades neither triangular nor cordate.

Plant tall, 5-15 dm. high; heads numerous.

V. SERRAE.

Plant low, 2-4 dm. high; heads few.

Heads radiate.

VI. CRASSULI.

Heads discoid.

VII. RAPIFOLII.

Leaves pinnatifid.

XVI. ERIMOPHILI.

Leaves or their divisions linear-filiform.

XVII. LONGILOBI.

Plants with the stem-leaves more or less reduced upwards.

Rootstock very short, erect, of short duration, with numerous fleshy-fibrous roots; leaves dentate or entire.

Tall bog-plant, 5-15 dm. high; basal leaves long-petioled.

VIII. HYDROPHILI.

Meadow or wood plants, 2-5 dm. high; basal leaves comparatively short-petioled.

Leaves sharply and densely dentate.

VI. CRASSULI.

Leaves entire-margined or denticulate, seldom sinuate-dentate.

IX. INTEGERRIMI.

Rootstock better developed, horizontal or ascending, woody.

Stem leafy, more than 2 dm. high.

Stem stout; rootstock not caespitose; leaves callous denticulate or saliently dentate.

Heads discoid; leaves saliently dentate.

VII. RAPIFOLII.

Heads radiate; leaves callous denticulate.

Leaves glabrous.

X. GLAUCENTES.

Leaves tomentose.

XI. ATRATI.

Stem slender; rootstock usually more or less caespitose; leaves neither callous-denticulate nor saliently and closely dentate; stem-leaves in the larger forms usually pinnatifid.

Basal leaves entire, more or less white-tomentose.

XII. CANI.

Basal leaves, at least most of them, toothed or pinnatifid.

Leaves and stem more or less floccose, tardily becoming glabrate.

XIII. TOMENTOSI.

Leaves and stem glabrous or slightly floccose when young.

XIV. AUREI.

Stem subscapose, less than 2 dm. high.

XV. ANDICOLAE.

I. PUDICI.

Heads 12-20 mm. high, broadly campanulate.

Mid-vein of the leaves long-villous.

Mid-vein of the leaves not villous.

Involucre green; plant more or less hairy.

Involucres purple; plant glabrous.

Heads 8-10 mm. high, narrowly campanulate.

1. *S. scopulinus*.

2. *S. chloranthus*.

3. *S. contristatus*.

4. *S. pudicus*.

II. AMPLECTENTES.

Stem-leaves clasping; stem over 15 cm. high.

5. *S. amplexans*.

Stem-leaves not clasping, usually short-petioled.

Stem 3 dm. or more high, leafy.

6. *S. pagosanus*.

Stem less than 2 dm. high.

Basal leaves gradually tapering into the petioles.

Plant glabrous or nearly so; leaves dentate; bracts oblong.

7. *S. Holmii*.

Plant arachnoid; leaves runcinate; bracts narrowly lanceolate.

8. *S. taraxacoides*.

Basal leaves abruptly contracted into the petioles.

9. *S. Soldanella*.

III. OCCIDENTALES.

Plant 2-3 dm. high; stem-leaves obovate or oblong, clasping.

Plant very leafy; involucre about 2 cm. broad, short-peduncled or sessile; achenes strigose.

Plant less leafy; involucre about 15 mm. broad, distinctly peduncled; achenes glabrous.

Plant about 1 dm. high; stem-leaves spatulate or ovate, not clasping.

10. *S. carthamoides*.

11. *S. blitoides*.

12. *S. invenustus*.

IV. TRIANGULARES.

One species.

13. *S. triangularis*.

V. SERRAE.

Heads 12-15 mm. high; disk 8-15 mm. broad; whole plant dark green.

Heads 8-10 mm. high; disk 5-6 mm. broad; plant light green.

14. *S. admirabilis*.

15. *S. serra*.

VI. CRASSULI.

Stem-leaves linear or linear-lanceolate.

Stem-leaves ovate or ovate-lanceolate.

Leaves firm; bracts thick and fleshy.

Leaves thin; bracts not very thick.

16. *S. lapathifolium*.

17. *S. crassulus*.

18. *S. semiamplexicaulis*.

VII. RAPIFOLII.

One species.

19. *S. rapifolius*.

VIII. HYDROPHILI.

One species.

20. *S. hydrophilus*.

IX. INTEGERRIMI.

Bracts without black tips; leaves entire-margined.

Bracts usually black-tipped; leaves more or less dentate or denticulate.

Bracts of the involucre narrowly linear-lanceolate, long attenuate.

Leaves thick; basal ones obovate, dentate.

Leaves thin; basal ones oblanceolate or spatulate, merely denticulate.

21. *S. integerrimus*.

22. *S. Hookeri*.

23. *S. dispar*.

Bracts of the involucre linear or oblong, rather abruptly acute, with lanceolate or triangular tips.

Basal leaf-blades orbicular to broadly oval, rather abruptly contracted into the petioles.

Basal leaf-blades spatulate to linear-oblanceolate or rarely lanceolate, gradually tapering into the petioles.

Inflorescence even in age a flat-topped corymb; leaves more or less dentate.

Inflorescence with a short-peduncled terminal head and the lateral ones usually very long-peduncled; leaves merely callous denticulate.

Basal leaves thick; their petioles shorter than the blades.

Basal leaves thin; their petioles usually longer than the blades.

24. *S. Flintii*.

25. *S. columbianus*.

26. *S. perplexus*.

27. *S. dispar*.

X. GLAUCENTES.

One species.

28. *S. anacletus*.

XI. ATRATI.

Bracts broadly linear, abruptly acute.

Bracts narrowly linear, long-acute.

29. *S. atratus*.

30. *S. milliflorus*.

XII. CANI.

Heads 7-8 mm. high.

Heads 1 cm. or more high.

31. *S. Purshianus*.

32. *S. Harbournii*.

XIII. TOMENTOSI.

Basal leaves mostly dentate or crenate.

Basal leaves obovate or spatulate.

Lower stem-leaves acute; plant dark green.

32. *S. plattensis*.

Lower stem-leaves obtuse; plant yellowish-green.

53. *S. flavulus*.

Basal leaves lanceolate or oblanceolate.

Basal leaves narrowly oblanceolate, serrate.

33. *S. salicinus*.

Basal leaves lanceolate, sinuate-dentate.

34. *S. canovirens*.

Some of the basal leaves entire or dentate, the rest pinnatifid or pinnately lobed.

Plant conspicuously rosulate-stoloniferous; stem-leaves sinuately round-lobed.

35. *S. rosulatus*.

Plant not stoloniferous; stem-leaves pinnatifid with toothed lobes.

32. *S. plattensis*.

All leaves pinnatifid with toothed segments.

Caudex subligneous; plant tomentose; bracts shorter than the disk.

Leaves mostly flat and deeply pinnatifid.

36. *S. Fendleri*.

Leaves very crisp with short-rounded lobes.

37. *S. lanatifolius*.

Caudex not subligneous; plant glabrate.

38. *S. multilobatus*.

XIV. AUREI.

Basal leaves pinnatifid.

38. *S. multilobatus*.

Basal leaves not pinnatifid.

Heads radiate.

Leaves thick, more or less fleshy.

Basal leaves narrowly oblanceolate.

Plant low, less than 2 dm. high, often with several stems from the base; basal leaves short-petioled.

Cyme dense; upper leaves generally pinnatifid with narrow lobes.

39. *S. condensatus*.

Cyme more open; stem-leaves entire or merely crenate.

Basal leaves subentire or 3-toothed at the apex.

40. *S. tridenticulatus*.

Basal leaves crenate.

41. *S. oblanceolatus*.

Plant 3-6 dm. high; basal leaves 1 dm. or more.

42. *S. longipetiolatus*.

Basal leaves cuneate, spatulate, broadly oblanceolate or orbicular, subentire at the base.

Lower stem-leaves spatulate with a broad-winged petiole; upper ones sessile and with much enlarged bases.

43. *S. crocatus*.

Stem-leaves neither broad-winged nor with much enlarged bases.

All leaves large, broadly obovate, coarsely toothed.

44. *S. oodes*.

Upper stem-leaves reduced, either pinnatifid or very narrow.

Basal leaves crenate above the middle.

45. *S. cymbalarioides*.

Basal leaves sharply dentate or serrate above the middle.

46. *S. subcuneatus*.

Leaves thin.

Earliest basal leaves cordate or reniform, rarely ovate.

Basal leaves entire or merely wavy.

Stem-leaves pinnatifid with dilated auricled bases; rays orange or red.

47. *S. pyrrhochrous*.

Stem-leaves entire or nearly so, not auricled; rays yellow.

48. *S. Tracyi*.

Basal leaves serrate or crenate.

Basal leaves usually coarsely serrate; heads 8-10 mm. high.

49. *S. pseudoreus*.

Basal leaves small, crenate; heads 8 mm. or less high.

50. *S. Hartianus*.

Basal leaves obovate or oval, crenate or sinuate-dentate.

- Stem-leaves lanceolate or oblanceolate in outline, with narrow segments. 53. *S. flavulus*.
- Stem-leaves spatulate or oblanceolate in outline, with short and broad segments. 51. *S. mutabilis*.
- Heads discoid.
- First basal leaves reniform. 52. *S. nephrophyllus*.
- None of the leaves reniform.
- Plant yellowish or light green, 3-5 dm. high. 53. *S. flavulus*.
- Plant dark green, about 1.5 dm. high. 54. *S. fedifolius*.
- XV. ANDICOLAE.
- Blades of the basal leaves reniform, orbicular, obovate or cuneate; toothed at least at the apex, obtuse.
- Rays golden yellow. 55. *S. petrocallis*.
- Rays pale-yellow.
- Involucre hemispherical to campanulate.
- Flowering stems about 2 dm. high; heads 9-10 mm. high; basal leaves crenate-serrate, except at the very base. 56. *S. cognatus*.
- Flowering stems less than 1.5 dm. high; heads 10-12 mm. high.
- Heads several; leaf-blades obovate or ovate, slightly tomentose. 57. *S. pentodontus*.
- Heads solitary; leaf-blades reniform, glabrous. 58. *S. Porteri*.
- Involucre turbinate. 59. *S. turbinatus*.
- Blades of the basal leaves elliptical to linear, entire or very rarely some of them 3-toothed at the apex, acute.
- Leaves elliptic; heads about 1 cm. high. 60. *S. perennans*.
- Leaves narrowly oblanceolate; heads 7-8 mm. high or the central one rarely 1 cm. 61. *S. werneriaefolius*.

XVI. ERIMOPHILI.

- One species. 62. *S. MacDougalii*.

XVII. LONGILOBI.

- Plant more or less permanently tomentose. 63. *S. filifolius*.
- Plant glabrous, at least in age.
- Leaves, except those of the branches, pinnately divided.
- Heads campanulate; bracts 12-15. 64. *S. Riddellii*.
- Heads almost cylindrical; bracts 8-10. 65. *S. multicapitatus*.
- Leaves entire, linear-filiform or some rarely with a pair of filiform lobes. 66. *S. spartioides*.

1. *Senecio scopulinus* Greene. (*S. Bigelovii Hallii* A. Gray) In the mountains of Colo. and Wyo.—Alt. 8000-10,000 ft.—North Park; Parlin; Veta Pass; Yampa; Empire; Steamboat Springs; Grizzly Creek.

2. *Senecio chloranthus* Greene. In the mountains of Colo.—Alt. 9000-11,000 ft.—Coffee Pot Springs; White River Plateau; Marshall Pass; near Pagosa Peak; Ruxton Dell; La Plata River; Alpine Tunnel; Bald Mountain; Vance Junction; Medicine Bow Range; Twin Lakes.

3. *Senecio contristatus* Greene. In the mountains of Colo.—Alt. about 10,000 ft.—Kebler Pass.

4. *Senecio pudicus* Greene. (*S. cernuus* A. Gray; not L.) In the mountains of Colo.—Alt. 7000-12,000 ft.—Clear Creek; Georgetown; Mt. Harvard; Como; Mt. Ouray; Black Cañon; Bear Creek Cañon, near Pike's Peak; Ute Pass; Cheyenne Cañon; Pike's Peak; Twin Lakes; west of Ouray; between Pallas and Sydney; Grand Lake; Minnehaha; Empire; between Sunshine and Ward; Como; Marshall Pass; Lake City.

5. *Senecio amplexatus* A. Gray. In alpine and subalpine regions of Colo.—Alt. 9000-13,000 ft.—Peak near White House; Silverton; Mt. Harvard; Gray's

Peak; near Pagosa Peak; Ruby; mountains above Ouray; Berthoud Pass; headwaters of Clear Creek.

6. *Senecio pagosanus* Heller. (*S. lactucinus* Greene of 1900; not of 1893) In the mountains of Colo.—Alt. 10,000–12,000 ft.—Little Kate Mine, La Plata Mountains; near Pagosa Peak; mountains above Ouray; Mt. Harvard.

7. *Senecio Holmii* Greene. On alpine peaks of Colo.—Alt. 10,000–14,000 ft.—Ragged Mountain; Keblar Pass; Mt. Princeton; near Pagosa Peak; Mt. Harvard; Cameron Pass; mountains above Boreas.

8. *Senecio taraxacoides* (A. Gray) Greene. (*S. amplexans taraxacoides* A. Gray) On alpine peaks of Colo.—Alt. 10,000–13,000 ft.—Cameron Pass; Mt. Garfield; Pike's Peak; Mt. Harvard; Bottomless Pit, near Pike's Peak; West Spanish Peak; Gray's Peak.

9. *Senecio Soldanella* A. Gray. On alpine peaks of Colo.—Alt. 11,000–14,000 ft.—Mt. Princeton; Cameron Pass; Boreas; Cumberland Mine, La Plata Mountains; mountains above Cameron Pass; South Park.

10. *Senecio carthamoides* Greene. (*S. Fremontii* A. Gray, in part; not T. & G.) In rocky wet places on alpine peaks of Colo. and Wyo.—Alt. 9000–13,000 ft.—Ragged Mountain; mountains of Estes Park; Gray's Peak; West Spanish Peak; Pike's Peak; Silver Plume; Mt. Harvard; summit of Mt. Garfield; near Pagosa Peak; Upper La Plata River; Keblar Pass; Berthoud Pass; Chambers' Lake; headwaters of Clear Creek; Massif de l'Arapahoe.

11. *Senecio blitoides* Greene. (*S. Fremontii* A. Gray, in part; not T. & G.) In wet rocky places on the higher mountains of Colo.—Alt. 8000–12,000 ft.—Mountains above Ouray; Crested Butte.

12. *Senecio invenustus* Greene. On the higher peaks of Colo.—Alt. about 12,000 ft.—Near Pagosa Peak; Pike's Peak.

13. *Senecio triangularis* Hook. In wet places, especially along mountain streams, from Alb. and Alaska to Colo. and Calif.—Alt. 8000–11,000 ft.—Mt. Harvard; Ruby; Upper La Plata River; Steamboat Springs; Cameron Pass; headwaters of Pass Creek; Delta Co.; near Pagosa Peak; Mt. Ouray; Marshall Pass; Red Mountain road, south of Ouray; between Sunshine and Ward; Buffalo Pass; Berthoud Pass; Hematite; Gore Pass; Beaver Creek; Michigan Creek; Breckenridge; headwaters of Clear Creek; summit of North Park Range.

14. *Senecio admirabilis* Greene. In the mountains of Colo. and Wyo.—Alt. 7500–10,000 ft.—Twin Lakes; Four-mile Hill, Routt Co.; Trappers' Lake; Breckenridge; Box Cañon, west of Ouray; Mt. Harvard; Keblar Pass; Marshall Pass; Empire; Vance Junction.

15. *Senecio serra* Hook. In valleys from Mont. and Wash. to Colo. and Ore.—Gunnison Co.; Grizzly Creek.

16. *Senecio lapathifolium* Greene. In the mountains of Colo.—Alt. about 12,000 ft.—Mountains above Ouray; Mt. Harvard.

17. *Senecio crassulus* A. Gray. In the mountains from Mont. and Ida. to Colo. and Utah.—Alt. 8000–13,000 ft.—Silver Plume; Ward, Boulder Co.; Trappers' Lake; Cameron Pass; mountains above Ouray; North Park; mountain sides near Empire; Little Kate Mine and Cumberland Mine, La Plata Mountains; near Pagosa Peak; Eldora to Baltimore; head of the Red River, Franklin; mountain northeast of Boreas; Gray's Peak; Boreas; headwaters

of Clear Creek; Rabbit-Ears, Larimer Co.; summit of North Park Range, Routt Co.

18. *Senecio semiamplexicaulis* Rydb. In meadows from Mont. and Ida. to Colo. and Utah.—Foot of Mt. Richtofen on the Michigan; Chambers' Lake.

19. *Senecio rapifolius* Nutt. In the mountains from S. D. and Ida. to Colo.—Alt. 7500–8500 ft.—Andrews' Shetland ranch; Bosworth's ranch, Stove Prairie; mountains, Larimer Co.

20. *Senecio hydrophilus* Nutt. In shallow water and swampy ground from Mont. to Colo. and Nev.—Alt. about 8000 ft.—Grizzly Creek, North Park; Montrose; six miles above Wolcott; swampy places near Yampa; Upper Laramie River; North Fork, Larimer Co.

21. *Senecio integerrimus* Nutt. In valleys from S. D. to Neb. and Colo.—Alt. 5000–10,000 ft.—Wolcott, Eagle Co.; mountain near Veta Pass; headwaters of Sangre de Cristo Creek; Owl Cañon, Larimer Co.

22. *Senecio Hookeri* A. Gray. In the mountains from Alb. and B. C. to Colo.—Alt. 8500–9500 ft.—Eldora to Baltimore.

23. *Senecio dispar* A. Nels. In mountain valleys of Wyo. and Colo.—Steamboat Springs.

24. *Senecio Flintii* Rydb. Hills of southwestern Colo.—Exact locality not given.

25. *Senecio columbianus* Greene. (*S. lugens* A. Gray, mainly; not Richardson; *S. atripiculatus* Rydb.) In valleys from Sask. and Alaska to Minn. and Colo.—Alt. 5000–13,000 ft.—Hills southeast of La Veta; Calhan; Ojo; Tennessee Pass; Veta Mountain; Sangre de Cristo Creek; Rist Cañon; Horsetooth Gulch; gulch west of Soldier Cañon; Horsetooth Mountain; Gray's Peak; headwaters of Clear Creek; Los Pinos.

26. *Senecio perplexus* A. Nels. In mountain valleys from Wyo. and Ida. to Colo.—Alt. 8000–10,500 ft.—Robinson; Ojo; Chicken Creek, west of Mt. Hesperus; Mt. Harvard; Veta Mountain; headwaters of Sangre de Cristo Creek; Bob Creek, west of Mt. Hesperus; Cimarron; Eldora to Baltimore; Boulder; Horsetooth Gulch; Horsetooth Mountain; Gore Pass; Lake City.

27. *Senecio anacletus* Greene. (*S. Toluccanus microdontus* A. Gray; *S. microdontus* Heller) In valleys from Colo. to N. M. and Ariz.; also in Mex.—Alt. 8000–11,000 ft.—Mt. Harvard; Veta Mountain; Dolores; Redcliffe; headwaters of Pass Creek; Tennessee Pass; Little Kate Mine, La Plata Mountains; Hematite; mountains north of Dolores; Leroux Parks; Silverton; Beaver Creek; headwaters of Clear Creek.

28. *Senecio atratus* Greene. (*S. lugens foliosus* A. Gray) In the mountains of Colo.—Alt. 7500–13,000 ft.—West of Ouray; Red Mountain road, south of Ouray; Ragged Mountain; vicinity of Como; West Spanish Peak; La Plata Cañon; Ward; mountains above Ouray; Marshall Pass; Como, South Park; Georgetown; Mt. Princeton; Mt. Harvard; Eldora to Baltimore; between Sunshine and Ward; Berthoud Pass; Marshall Pass; Clear Creek Cañon, above Georgetown; Como; Silverton; mountain sides near Empire; Lake City.

29. *Senecio milliflorus* Greene. In the mountains of Colo.—Pagosa Springs.

30. *Senecio Purshianus* Nutt. (*S. canus* A. Gray, in part; not Hook.) In the mountains from Sask. and B. C. to Tex. and Utah.—Alt. 6000–13,000 ft.—Mountain northeast of Boreas; Rabbit-Ears, Larimer Co.

31. *Senecio Harbourii* Rydb. Mountains of Colorado.—Alt. 9000–13,000 ft.—Silver Plume; mountains south of Ward, Boulder Co.; mountains between Sunshine and Ward; Boreas.

32. *Senecio plattensis* Nutt. On prairies and in river valleys from western Ont. and S. D. to Tex. and Colo.—Alt. 4000–7000 ft.—Cache la Poudre River; Ft. Collins; New Windsor; Boulder; Horsetooth Gulch; Cimarron; Florence.

33. *Senecio salicinus* Rydb. In the mountains of Colo.—Alt. 5000–6000 ft.—Foot-hills, Larimer Co.; Veta Pass; Owl Cañon, Larimer Co.

34. *Senecio canovirens* Rydb. In the mountains of Colo. and N. M.—Alt. 6000–10,000 ft.—Florence; Williams Cañon; Colorado Springs; Manitou; Georgetown; Pike's Peak; Buckhorn Creek.

35. *Senecio rosulatus* Rydb. On hills and mountains of Colo.—Alt. 5000–13,000 ft.—Cameron Pass; Dillon Cañon; Trinidad; Pike's Peak; foot-hills west of Ft. Collins; Georgetown; Chambers' Lake; Gray's Peak; Sangre de Cristo Creek; Manitou; Grayback mining camps; Artists' Glen, near Pike's Peak; Green Mountain Falls; North Cheyenne Cañon; mountain sides near Georgetown; Silver Plume; New Windsor; Marshall Pass; Dark Cañon; Horsetooth Gulch; dry hills near Wood's ranch; near Narrows; Howe's Gulch; Rist Cañon; Baxter's ranch; above Beaver Creek; Caribou; Cheyenne Mountain; mountain sides near Golden; Bottomless Pit; Twin Lakes; Cañon City; Empire; Boulder; between Sunshine and Ward.

36. *Senecio Fendleri* A. Gray. On mountains from Colo. to Utah and N. M.—Alt. 8000–13,000 ft.—Manitou; Mt. Ouray; Bottomless Pit; Ojo; hills north of Cascade; mountains near Colorado Springs; Grayback mining camps; Clear Creek; Hematite.

37. *Senecio lanatifolius* Osterhout. (*S. Fendleri lanatus* Osterhout) In the mountains of Colo.—Wolcott, Eagle Co.

38. *Senecio multilobatus* T. & G. On dry plains of Colo. and Utah.—Alt. about 7000 ft.—Dolores; Cañon of the Grand, above Palisades; Steamboat Springs; Grand Junction; Mancos; Minturn.

39. *Senecio condensatus* Greene. (*S. aureus compactus* A. Gray; *S. compactus* Rydb.) On dry plains and in sandy soil in Neb. and Colo.—Trinidad; Table Rock; Colorado Springs.

40. *Senecio tridenticulatus* Rydb. On dry plains from Colo. to Tex.—Alt. 7000–8000 ft.—Cottonwood Creek, Buena Vista; hills southeast of La Veta.

41. *Senecio oblanceolatus* Rydb. On dry plains and hills from Wyo. to Tex.—Alt. 4000–10,000 ft.—Arboles; Los Pinos; Pike's Peak; Calhan; Como, South Park; El Paso Co.; mesas near Colorado Springs; Cucharas Valley, near La Veta; plains near Denver; Sangre de Cristo Creek; Turkey Creek and tributaries; Cottonwood Creek, near Buena Vista; Quimby; hills about Trinidad; Como; Clear Creek.

42. *Senecio longipetiolatus* Rydb. In valleys of Wyo. and Colo.—Alt. up to 9000 ft.—Medicine Bow Range; Hamor's Lake, north of Durango.

43. *Senecio crocatus* Rydb. (*S. aureus croceus* A. Gray; *S. dimorphophyllus* Greene; *S. heterodoxus* Greene) On the higher mountains of Wyo. and Colo.—Alt. 10,000–14,000 ft.—Pike's Peak Valley; Mt. Harvard; near Pagosa Peak; Cameron Pass; summit of mountains west of North Park; Little Kate Mine, La Plata Mountains; Alpine Tunnel; South Cottonwood Gulch, Chaffee Co.; Long's Peak; Red Mountain; Berthoud Pass; Grass Creek; Red River; Beaver Creek; Gray's Peak; summit of North Park Range, Larimer Co.

44. *Senecio oodes* Rydb. Mountains of Colo.—Mt. Harvard; Robinson.
45. *Senecio cymbalarioides* Nutt. (*S. aureus borealis* T. & G.) In meadows from the Mackenzie to Colo. and Utah.—Alt. 7000-13,000 ft.—West Spanish Peak; Marshall Pass; Rabbit-Ear Range; Mt. Harvard; Redcliffe; peak near White House; Hematite; Mancos.
46. *Senecio subcuneatus* Rydb. In meadows of Colo. and Wyo.—Alt. 7000-8500 ft.—Arboles; Grizzly Creek; Hamor's Lake; Mancos; Lake City.
47. *Senecio pyrochrous* Greene. In wet meadows of Wyo. and Colo.—Alt. 8000-9500 ft.—Mt. Harvard; Hamor's Lake, north of Durango; Sargents; Marshall Pass; Medicine Bow Range; Sheephorn Divide, Middle Park; Jack's Cabin; Rico; Silverton.
48. *Senecio Tracyi* Rydb. Mountains of Colo.—Alt. 10,500 ft.—Bob Creek, west of Mt. Hesperus.
49. *Senecio pseudoreus* Rydb. In wet meadows from the Mackenzie and B. C. to N. M. and Nev.—Alt. 7000-13,000 ft.—Mancos; Long's Peak; Grizzly Creek.
50. *Senecio Hartianus* Heller. In wet meadows from Colo. to N. M. and Ariz.—Alt. 7000-9000 ft.—Minturn, Eagle Co.; Cucharas River, below La Veta; headwaters of Sangre de Cristo Creek; Veta Pass; along the Conejos River, north of Antonito.
51. *Senecio mutabilis* Greene. (*S. aurellus* Rydb.) In valleys of Colo.—Alt. 5000-9000 ft.—Hotchkiss; Cimarron; Lake John, North Park; La Plata Cañon; Sapinero; Cucharas River, below La Veta; Arboles; Mancos; Los Pinos; Rico; Hotchkiss; Florence; Colorado Springs.
52. *Senecio nephrophyllus* Rydb. In wet meadows from Mont. to Colo.—Near Lake John, North Park.
53. *Senecio flavulus* Greene. (*S. flavovirens* Rydb.) In wet meadows from Mont. and Ida. to Colo.—Alt. 5000-7000 ft.—Gypsum Creek Cañon; Walton Creek, Routt Co.; Dolores; Laramie Plains; La Veta; New Windsor; Arboles; Sapinero; Black Cañon; Brant's Soda Spring; Walton Creek; Horsetooth Gulch; Walden.
54. *Senecio fedifolius* Rydb. Wet places in alpine regions of Colo.—South Park.
55. *Senecio petrocallis* Greene. (*S. petraeus* Klatt) On alpine peaks of Colo.—Alt. 11,000-13,000 ft.—Near Pagosa Peak; mountains above Ouray; Gray's Peak; Lake City.
56. *Senecio cognatus* Greene. On high mountains of Colo.—Piedra.
57. *Senecio pentodontus* Greene. On alpine mountains of Wyo. and Colo.—Alt. 10,000-12,000 ft.—Upper La Plata Cañon; West Spanish Peak; Carson; Lake City; Chicken Creek, west of Mt. Hesperus.
58. *Senecio Porteri* Greene. (*S. renifolius* Porter) Alpine regions of Colo.—Alt. 13,000 ft.—White House Mountain.
59. *Senecio turbinatus* Rydb. Mountains of Colo.—Lake City.
60. *Senecio perennans* A. Nels. On the higher mountains of Wyo. and Colo.—Alt. 8000-10,500 ft.—Grayback mining camps; Hahn's Peak; Redcliffe; Silver Plume.
61. *Senecio werneriaefolius* A. Gray. On the peaks of Colo.—Alt. 8000-10,000 ft.—Empire; Cameron Pass.
62. *Senecio MacDougalii* Heller. (*S. eremophilus* A. Gray, mainly; not

Richardson) In wet wooded places from N. D. and Mont. to N. M. and Ariz.—Alt. 6000–10,000 ft.—Four-Mile Hill, Routt Co.; Pandora; Ute Pass; Chambers' Lake; mesa near Yampa; Green Mountain Falls; Parlin; Ruxton Park; Parrott City; Gunnison; near Pagosa Peak; Steamboat Springs; near Colorado Springs; Sangre de Cristo Creek; Silver Plume; La Veta; Ward; Spring Cañon; Georgetown; above Beaver Creek; cañon west of Palmer Lake; Hotchkiss; headwaters of Clear Creek.

63. *Senecio filifolius* Nutt. (*S. Douglasii* A. Gray, in part; not DC.) In valleys from Colo. and Utah to Tex. and Ariz.; also in Mex.—Florence; Westcliffe; Estes Park, Larimer Co.; Cañon City; Pueblo.

64. *Senecio Riddellii* T. & G. (*S. filifolius Fremontii* T. & G.; *A. Douglasii* A. Gray, in part; *S. Fremontii* Rydb.; not T. & G.) On plains and in valleys from Neb. and Colo. to Tex. and N. M.—Alt. 4000–6000 ft.—Brantly Cañon; Boulder; Ft. Collins; Cimarron and Squaw Hill.

65. *Senecio multicapitatus* Rydb. On plains and in valleys from Colo. to N. M. and Ariz.—Alt. 7000–11,000 ft.—Huerfano Valley, near Gardner; Mt. Princeton Station.

66. *Senecio spartioides* T. & G. (*S. Douglasii* A. Gray, in part) On plains and in valleys from Neb. and Wyo. to Tex. and Ariz.—Alt. 4000–9500 ft.—Ft. Collins; Idaho Springs; Engelmann Cañon; along the Uncompahgre River, near Ouray; Gunnison; Salida; Cucharas Valley, near La Veta; Pike's Peak; Antonito; Empire; mountains between Sunshine and Ward; Rist Cañon; Cache la Poudre River; Buena Vista; Golden; Colorado Springs.

87. TETRADYMIA DC.

Shrub not spiny.

Primary leaves oblanceolate.

Primary leaves linear.

Shrub spiny.

1. *T. inermis*.

2. *T. linearis*.

3. *T. spinosa*.

1. *Tetradymia inermis* Nutt. Dry hills from Mont. to Colo. and Nev.—Alt. 4000–9000 ft.—Gunnison; North Park, Larimer Co.; La Veta; Cerro Summit; Leroux Creek; North Fork, Larimer Co.

2. *Tetradymia linearis* Rydb. On dry hills and plains of Colo. and Utah.—Alt. about 7700 ft.—Gunnison; La Veta.

3. *Tetradymia spinosa* H. & A. On dry hills and plains from Mont. and Ore. to Colo. and Nev.—Alt. 4500–7000 ft.—Mancos; near Wyoming line, Routt Co.; Hotchkiss; Mancos Cañon; Grand Junction; Palisades.

Tribe 9. CYNAREAE.

88. CARDUUS L. THISTLE.

Bracts of the involucre conspicuously arachnoid-pubescent, neither reflexed nor spreading, except the tips.

Inner bracts with conspicuously dilated tips.

Inner bracts long-attenuate, rarely slightly dilated.

Bracts of the involucre not arachnoid or only slightly so on the margins,

Bracts not with a dorsal glandular ridge.

Bracts, except the outermost, with dilated fimbriate tips.

I. VIRIDIFLORI.

II. ERIOCEPHALI.

III. CARLINOIDES.

Bracts, except the innermost, not with dilated tips.

Bracts not squarrose, except the spines or the loose tips.

Innermost innocuous bracts not conspicuously elongated; their tips usually crisp or twisted, sometimes erose or laciniate.

IV. SCARIOSI.

Innermost innocuous bracts conspicuously elongated and more or less reddish, straight, neither dilated, crisp, twisted, nor erose.

V. PULCHELLI.

IX. NEO-MEXICANI.

Bracts squarrose or the lower reflexed.

Bracts with glandular dorsal ridge.

Flowers perfect.

Leaves tomentose on both sides.

Leaves glabrate above.

Flowers dioecious.

VI. UNDULATI.

VII. ALTISSIMI.

VIII. ARVENSES.

I. VIRIDIFLORI.

One species.

1. *C. Parryi*.

II. ERIOCEPHALI.

Anthers glabrous.

Lobes at least of the larger leaves elliptic or ovate, obtuse; spines of the bracts stout.

2. *C. Osterhoutii*.

Lobes of the leaves triangular or lanceolate, acute; spines of the bracts slender, yellow.

Stem tomentose or glabrous.

Involucres densely arachnoid.

Outer bracts with longer spines, almost equalling the inner; flowers red.

3. *C. Hookerianus*.

Outer bracts much shorter than the inner; flowers whitish.

4. *C. araneosus*.

Involucres sparingly arachnoid.

Stem arachnoid hairy.

5. *C. oreophilus*.

Anthers pubescent.

6. *C. scopulorum*.

7. *C. hesperius*.

III. CARLINOIDES.

Bracts all linear-lanceolate, not very unlike in length, with long stout flat spines.

8. *C. griseus*.

Bracts with short weak spines; the outer ovate or ovate-lanceolate; the inner with broad dilated tips.

Flowers ochroleucous; bracts not at all glandular ridged.

Heads campanulate; tips of the bract fimbriate.

9. *C. Centaureae*.

Heads hemispherical; tips of the bracts erose.

10. *C. erosus*.

Flowers red; bracts with a more or less distinct glandular ridge.

11. *C. perplexans*.

IV. SCARIOSI.

Plants acaulescent or nearly so.

Bracts all with short spines.

12. *C. acaulescens*.

Bracts, at least the middle ones, with long spines equalling the disk.

13. *C. americanus*.

Plants distinctly caulescent.

Tips of the inner bracts usually more or less dilated; at least the terminal head 3-4 cm. wide.

Bracts thin and flat, greenish or brownish.

14. *C. foliosus*.

Bracts thick and firm, yellowish, only the tips brownish, more or less rounded or carinate on the back, ovate.

Divisions of the leaves broad, ovate.

15. *C. coloradensis*.

Divisions of the leaves narrow, linear-lanceolate.

16. *C. scariosus*.

Tips of the inner bracts usually not at all dilated; heads 2-2.5 cm. in diameter.

Bracts narrowly lanceolate, usually arachnoid-hairy, gradually tapering to long, flat spines.

5. *C. oreophilus*.

Bracts broadly lanceolate, scarcely arachnoid with a very short spine.

17. *C. spathulatus*.

V. PULCHELLI.

Leaves not white-tomentose beneath.

Leaves sparingly floccose when young, or glabrate.

Leaves glabrous, the lower twice pinnate.

Leaves white-tomentose beneath.

18. *C. truncatus*.

19. *C. bipinnatus*.

20. *C. pulchellus*.

VI. UNDULATI.

Flowers ochroleucous; bracts very viscid, with broad glandular dorsal ridges.

Tips of the inner bracts more or less dilated and crisp; involucre of the terminal head 4-5 cm. in diameter.

Tips of the inner bracts linear-lanceolate, neither dilated nor crisp; involucre usually 3 cm. wide or less.

Flowers rose or purple, rarely white; glandular ridge not so prominent.

Involucres less than 3 cm. wide.

Spines of the middle bracts 5-10 mm. long, erect or ascending.

Spines of the middle bracts 5 mm. or less long, weak and spreading.

Leaves entire or slightly lobed.

Leaves pinnately divided or deeply lobed.

Leaves deeply pinnatifid with narrow, linear-lanceolate lobes; plant often yellowish.

Leaves with triangular or ovate-lanceolate lobes.

Bracts with a very inconspicuous glandular ridge, not at all viscid.

Bracts with a conspicuous glandular ridge, surrounded by a viscid area.

Involucres 4-6 cm. in diameter.

Spines of the involucral bracts scarcely over 5 mm. long; leaves very broad.

Spines of the involucres 1 cm. long; leaves narrow.

21. *C. plattensis*.

22. *C. Tracyi*.

23. *C. canescens*.

24. *C. oblanceolatus*.

25. *C. Flodmanii*.

26. *C. floccosus*.

27. *C. undulatus*.

28. *C. megacephalus*.

29. *C. ochrocentrus*.

VII. ALTISSIMI.

One species.

30. *C. filipendulus*.

VIII. ARVENSES.

One species.

31. *C. arvensis*.

IX. NEO-MEXICANI.

One species.

32. *C. neo-mexicanus*.

1. *Carduus Parryi* (A. Gray) Greene. (*Cnicus Parryi* A. Gray) In the mountains of Colo., Utah and N. M.—Alt. 5000-11,000 ft.—Marshall Pass; La Veta; along the Uncompahgre River, near Ouray; Steele Cañon. Villa Grove; Redcliffe; Marshall Pass; Echo Creek, near La Veta; Veta Pass; near Pagosa Peak; Boulder; near Empire; Twin Lakes.

2. *Carduus Osterhoutii* Rydb. In the mountains of Colo.—Redcliffe; Tennessee Pass.

3. *Carduus Hookerianus* (Nutt.) Heller. (*Cnicus Hookerianus* A. Gray) In the mountains from Alb. and B. C. to Colo.—Alt. 11,000-12,000 ft.—Bert-houd Pass.

4. *Carduus araneosus* Osterhout. Mountains of Colo.—Redcliffe.

5. *Carduus oreophilus* Rydb. In wooded valleys of Colo.—Alt. 6000-12,000 ft.—Banks of Larimer Co.; Silver Plume; Georgetown; Pagosa Springs; Steamboat Springs; Boreas; Garland.

6. *Carduus scopulorum* Greene. (*Cnicus eriocephalus* A. Gray) In the mountains of Colo.—Alt. 9500-12,000 ft.—Ward; Mt. Harvard; head of Beaver Creek; Ruxton Dell; Mt. Baldy, Pike's Peak; Cameron Pass; Bert-houd Pass.

7. *Carduus hesperius* (Eastw.) Heller. (*Cnicus hesperius* Eastw.) In mountains of Colo., above timber line.—Mt. Hesperus.

8. *Carduus griseus* Rydb. In the mountains of Colo.—Alt. up to 12,000 ft.—Trappers' Lake; Bosworth's ranch, Stove Prairie; Steamboat Springs; Happy Hollow; Ward; Marshall Pass; Telluride.

9. *Carduus Centaureae* Rydb. (*Cnicus Americanus* A. Gray, in part) In the mountains of Wyo. and Colo.—Alt. 7000–10,000 ft.—Bosworth's ranch; Stove Prairie; mountains, Larimer Co.; Four-mile Hill, Routt Co.; Penn's Gulch; Steamboat Springs; mountains between Sunshine and Ward; Hinsdale Co.

10. *Carduus erosus* Rydb. In the mountains of Southern Colo.—Alt. about 7500 ft.—Durango.

11. *Carduus perplexans* Rydb. In the mountains of Colo.—Alt. about 7000 ft.—Cimarron.

12. *Carduus acaulescens* (A. Gray) Rydb. (*Cnicus Drummondii acaulescens* A. Gray) In the mountains of Colo.—Alt. 8000–10,000 ft.—Banks of Laramie River; on Grizzly Creek; Parlin, Gunnison Co.; Columbine; Marshall Pass; Empire.

13. *Carduus americanus* Rydb. (*Cirsium acaule Americanum* A. Gray) In mountain valleys of Colo.—Alt. about 10,000 ft.—Silver Plume; Como; South Park.

14. *Carduus foliosus* Hook. (*Cnicus foliosus* Gray) In the mountains from S. D. and B. C. to Colo.—Dillon.

15. *Carduus coloradensis* Rydb. (*Cnicus Drummondii* A. Gray, in part) In the mountains of Colo.—Alt. about 7500 ft.—Pagosa Springs; Gunnison; Wolcott.

16. *Carduus scariosus* (Nutt.) Heller. (*Cnicus scariosus* A. Gray) In the mountains of Wyo., Utah and Colo.—Alt. about 8500 ft.—Columbine.

17. *Carduus spathulatus* Osterhout. Hills of Colorado.—North Park.

18. *Carduus truncatus* Greene. On sage plains of Southern Colo.—West of Mancos.

19. *Carduus bipinnatus* (Eastw.) Heller. (*Cnicus bipinnatus* Eastw.) In cañons of southwestern Colo. It is scarcely distinct from the preceding.—Johnston Cañon, near Mancos River.

20. *Carduus pulchellus* Greene. In the mountains of Colo.—Piedra.

21. *Carduus plattensis* Rydb. On sand hills of Neb. and Colo.—New Windsor, Weld Co.; Wray.

22. *Carduus Tracyi* Rydb. On dry fields of Colo.—Alt. 5000–7000 ft.—Green Mountain Falls; Mancos; Ft. Collins and La Porte.

23. *Carduus canescens* Nutt. On dry plains and hills of Wyo. and Colo.—Alt. 7500–8500 ft.—Box Cañon, west of Ouray.

24. *Carduus ob lanceolatus* Rydb. In the mountains of Wyo. and Colo.—Twin Lakes.

25. *Carduus Flodmanii* Rydb. (*Cnicus undulatus canescens* A. Gray, mainly; not *Cirsium canescens* Nutt.; *Carduus canescens* Pammel) In river valleys from Minn. and Mont. to Iowa and Colo.—Alt. 4000–5000 ft.—Cache la Poudre; Ft. Collins; La Porte; Westcliffe; New Windsor, Weld Co.

26. *Carduus floccosus* Rydb. In the mountains of Colo.—Wolcott, Eagle Co.

27. *Carduus undulatus* Nutt. (*Cnicus undulatus* A. Gray) On dry plains

and hills from Mich., Ass. and Mont. to Tex. and Utah.—Alt. 4000-7000 ft.—Georgetown; near Grand Junction; Durango; Wolcott; Golden.

28. *Carduus megacephalus* Nutt. (*Cnicus undulatus megacephalus* A. Gray) On prairies, plains and hills from S. D. and Ida. to Mo., Tex. and Colo.—Alt. 4000-7500 ft.—Idaho Springs; Boulder; Cucharas Valley, near La Veta; Ft. Collins; Spring Cañon; Turkey Creek.

29. *Carduus ochrocentrus* (A. Gray) Greene. (*Cnicus ochrocentrus* A. Gray) On plains from Neb. and Colo. to Tex. and Ariz.—Alt. 4000-5000 ft.—Ft. Collins; New Windsor.

30. *Carduus filipendulus* (A. Gray) Rydb. (*Cirsium filipendulum* Engelm.; *Cnicus altissimus filipendulus* A. Gray) On prairies, valleys and waste places from Colo. to Tex.—Clear Creek Valley; Ft. Collins.

31. *Carduus arvensis* (L.) Robs. (*Cnicus arvensis* Hoffm.) In fields and waste places; an introduced weed from Europe and naturalized from Newf. and Ida. to N. J. and Colo.—Alt. 4000-5000 ft.—Livingstone; Ft. Collins.

32. *Carduus neo-mexicanus* (A. Gray) Greene. (*Cnicus Neo-Mexicanus* A. Gray; *C. leucopsis* Greene) On plains from Colo. to N. M. and Ariz.—Alt. 4000-6000 ft.—Grand Junction; Arboles; Rifle, Garfield Co.

Family 134. CICHORIACEAE Reich. CHICORY FAMILY.

I. Pappus of plumose bristles, often more or less paleaceous at the base.

Achenes truncate at the apex, not beaked.

Flowers yellow; simple plants with fusiform roots.

1. PTILOCALAIS.

Flowers pink, rose or white; branched plants with rush-like stems.

2. PTILORIA.

Achenes with long beaks; simple plants with fistulose leaves.

3. TRAGOPOGON.

II. Pappus not plumose.

A. Pappus consisting, at least partly, of chaffs or these reduced and united into a crown.

Involucres simple and naked, i. e., without smaller calyculate bracts below; pappus of both chaffs and bristles; flowers yellow.

4. ADOPOGON.

Involucres double, either imbricated or with smaller calyculate bracts below; flowers blue.

5. CICHORIUM.

B. Pappus of capillary bristles, not plumose, slightly if at all broadened below.

1. Achenes not flattened.

a. Pappus-bristles promptly deciduous, mainly together; only a few of the stouter ones in some species remaining.

6. MALACOTHRIX.

b. Pappus persistent, tardily falling off separately, or together only by the breaking off of the beak.

Beaks of the achenes none or a mere attenuation.

Flowers rose or purplish.

Stems rush-like and striate; leaves narrowly linear or reduced; achenes tapering at the summit.

7. LYGODESMIA.

Stems not rush-like; leaves ample; achenes tapering to the base.

Annuals; heads 4-5-flowered; achenes with 4-5 strong ribs.

8. PRENANTHELLA.

Perennials; heads 8-30-flowered (rarely less); achenes terete or 4-5-angled.

9. NABALUS.

Flowers yellow or white.

Heads several, rarely solitary; stem leafy.

Achenes tapering upwards; pappus white; bracts in fruit more or less thickened at the base or on the mid-rib.

10. CREPIS.

Achenes not tapering upwards; pappus in ours sordid or reddish; bracts not thickened.

11. HIERACIUM.

- Heads solitary on leafless scapes. 12. NOTHOCALAIS.
 Beaks of the achenes distinct and slender; plants scapiferous.
 Achenes 10-ribbed or 10-nerved, not spinose-muricate; involucre more
 or less imbricated. 13. AGOSERIS.
 Achenes 4-5-ribbed, muricate-spinulose at least near the apex; in-
 volucre of a single series of principal bracts and several or numer-
 ous calyculate ones below. 14. TARAXACUM.
 2. Achenes flattened; leafy-stemmed plants with paniculate heads.
 Achenes narrowed at the top or beaked; pappus-bristles falling separately;
 involucre cylindraceous. 15. LACTUCA.
 Achenes truncate at the top; pappus-bristles falling off more or less in
 connection; involucre hemispherical or campanulate. 16. SONCHUS.

1. PTILOCALAIS Greene.

1. *Ptilocalais nutans* (Geyer) Greene. (*Microseris nutans* A. Gray) Wet meadows from Mont. and Wash. to Colo. and Calif.—Alt. 8000-10,000 ft.—Minturn, Eagle Co.; Cerro Summit; Silver Plume.

2. PTILORIA Raf.

Perennials.

Pappus plumose to the base, white; leaves, at least the lower ones, broad, oblanceolate in outline and runcinate. 1. *P. ramosa*.

Pappus merely scabrous at the base, brown; leaves often runcinate, but narrow. 2. *P. pauciflora*.

Annuals or biennials.

Pappus plumose to the base, not paleaceous-dilated; plant strict, virgate; leaves entire or sinuate. 3. *P. virgata*.

Pappus plumose above the middle, dilated and paleaceous at the base; leaves pinnatifid or bipinnatifid or the upper bract-like. 4. *P. exigua*.

1. *Ptiloria ramosa* Rydb. On dry plains and in "bad-lands" from Neb. and Mont. to Colo.—Alt. 4000-6000 ft.—New Windsor; Boulder.

2. *Ptiloria pauciflora* (Torr.) Raf. (*Stephanomeria runcinata* Nutt.) On plains and hills from Colo. and Nev. to Tex. and Ariz.—Alt. 4500-8000 ft.—Buena Vista; Villa Grove; Mancos; Ft. Collins; Grand Junction; Deer Run; New Windsor; near Boulder; Hotchkiss; Cucharas Valley, near La Veta; Cañon City; between Sunshine and Ward; Boulder.

3. *Ptiloria virgata* (Benth.) Greene. (*Stephanomeria virgata* Benth.) In arid places from Colo. and Nev. to Calif.—Alt. about 4500 ft.—Grand Junction.

4. *Ptiloria exigua* (Nutt.) Greene. Dry places from Wyo. to N. M., Calif. and Nev.—Grand Junction (*Eastwood*).

3. TRAGOPOGON L. SALSIFY, OYSTER PLANT.

Flowers yellow; involucre bracts equalling or shorter than the ligules. .

1. *T. pratense*.

Flowers purple; involucre bracts much longer than the ligules.

2. *T. porrifolius*.

1. *Tragopogon pratensis* L. In fields and waste places from N. B. and Man. to N. J. and Colo.; naturalized from Europe.—Ft. Collins; Boulder.

2. *Tragopogon porrifolius* L. In fields and waste places from Ont. and Minn. to N. C. and Colo. Escaped from cultivation.—Ft. Collins; Colorado Springs.

4. **ADOPOGON** Necker. GOAT'S BEARD.

1. *Adopogon virginicum* (L.) Kuntze. (*Krigia amplexicaulis* Nutt.) In moist woods and meadows from Ont. and Man. to Ga. and Colo.—Alt. 6000-8500 ft.—Colorado Springs; mouth of Cheyenne Cañon; near Pike's Peak; North Cottonwood Creek.

5. **CICHORIUM** L. CHICKORY.

1. *Cichorium Intybus* L. On roadsides, fields and waste places from N. S. and Minn. to N. C. and Colo. Naturalized from Europe.—Alt. about 5000 ft.—Ft. Collins; La Porte, Larimer Co.; Denver.

6. **MALACOTHRIX** DC.

1. *Malacothrix sonchioides* T. & G. On plains from Neb. and Nev. to Kans. and Calif.—Alt. 4500-8000 ft.—Grand Junction; McCoy's, Eagle Co.

7. **LYGODESMIA** D. Don.

Perennials.

Involucres 15-25 mm. high, 6-10-flowered.

1. *L. grandiflora*.

Involucres about 10 mm. high, usually 5-flowered; upper leaves reduced.

2. *L. juncea*.

Annuals; leaves narrowly linear; involucres 10-15 mm. high. 3. *L. rostrata*.

1. *Lygodesmia grandiflora* T. & G. On gravelly hills from Wyo. and Ida. to Colo. and Ariz.—Alt. up to 7000 ft.—Mancos; Glenwood Springs; Hotchkiss; Grand Junction; Gypsum, Eagle Co.

2. *Lygodesmia juncea* (Pursh) D. Don. On prairies and plains from Minn., Sask. and Alb. to Mo. and N. M.—Alt. 4000-12,000 ft.—Gunnison; New Windsor; Ft. Collins; Denver; Pueblo; West Spanish Peak; Pagosa Springs; Table Rock; Fossil Creek; Manitou; Colorado Springs.

3. *Lygodesmia rostrata* A. Gray. In cañons and on sandy plains from S. D. and Sask. to Kans. and Colo.—New Windsor; Greeley.

8. **PRENANTHELLA** Rydb.

1. *Prenanthes exiguus* (A. Gray) Rydb. (*Lygodesmia exiguus* A. Gray) On stony hills from Colo. and Utah to Tex. and Ariz.—Grand Junction.

9. **NABALUS** Cass. RATTLESNAKE-ROOT.

1. *Nabalus racemosus* (Michx.) DC. (*Prenanthes racemosa* Michx.) In moist ground from N. B. and Sask. to N. J. and Colo.—Alt. 5000-9500 ft.—Westcliffe; Estes Park, Larimer Co.; Cabin Cañon, near Pike's Peak.

10. **CREPIS** L. HAWK'S-BEARD.

Achenes not discoid-dilated at the insertion of the pappus; plants tall.

Plants neither canescent nor furfurascens; heads hemispherical to turbinate.

Involucres glabrous or tomentulose when young; neither hirsute nor glandular.

Involucres and peduncles tomentulose, at least when young.

1. *O. tomentulosa*.

Involucres glabrous or slightly puberulent when young.

2. *C. glauca*.

Involucres and peduncles hirsute or glandular or both.

Leaf-blades oblanceolate or oblong to linear-oblanceolate.

Leaves long-petioled; petioles one-half as long to fully as long as the blades, not winged.

Blades of the basal leaves broadly oblanceolate; stem usually with 1-2 leaves; involucres over 1 cm. high. 3. *C. petiolata*.

Blades of the basal leaves narrowly linear-lanceolate or linear-oblanceolate; stem scapiform; involucres less than 1 cm. high. 4. *C. glauca*.

Leaves sessile or with short, winged petioles.

Leaves glabrous; involucres with a few short hairs. 5. *C. perplexa*.

Leaves and involucres hairy. 6. *C. runcinata*.

Leaf-blades obovate; involucres and peduncles densely glandular hispid with long hairs.

Involucres over 1 cm. high; leaves hairy, 1.5-2 dm. long. 7. *C. riparia*.

Involucres 1 cm. high or less; leaves glabrous or nearly so. 8. *C. denticulata*.

Plant more or less canescent or furfurulent, especially the leaves. 9. *C. acuminata*.

Involucres glabrous, 5-7-flowered.

Involucres canescent.

Involucres and peduncles without black hairs.

Principal bracts of the involucres 5-8; flowers of the same number.

Blade proper broadly lanceolate; lobes usually directed downward. 10. *C. intermedia*.

Blade proper narrowly lanceolate to almost linear; lobes curved upwards. 11. *C. angustata*.

Principal bracts of the involucres 9-14; flowers 10-20; plant low. 12. *C. pumila*.

Involucres and peduncles with some black hairs intermixed with the tomentum; principal bracts 9-10.

Hairs glandular. 13. *C. occidentalis*.

Hairs not glandular. 14. *C. scopulorum*.

Achenes with a more or less dilated disk bearing the deciduous pappus; plant dwarf, less than 1 dm. high. 15. *C. nana*.

1. *Crepis tomentulosa* Rydb. In the mountains near Pike's Peak, Colo.—Alt. nearly 10,000 ft.—Ruxton Dell.

2. *Crepis glauca* (Nutt.) T. & G. (*C. lancifolia* Greene ?) In valleys from Mont. to Colo. and Nev.—Alt. 4500-10,000 ft.—Clear Creek, below Georgetown; Ft. Collins; Doyle's; Garland; Wahatoya Creek; Eagle River.

3. *Crepis petiolata* Rydb. In the mountains of Wyo. and Colo.—Alt. 7000-9000 ft.—Along Bear River, five miles east of Hayden; Georgetown.

4. *Crepis glauca* Rydb. In wet meadows from Mont. to Colo.—Alt. about 7500 ft.—Wahatoya Creek.

5. *Crepis perplexa* Rydb. In valleys from N. D. and Alb. to Neb. and Colo.—Alt. 5000-9000 ft.—Sterling, Logan Co.; Garland; Parlin; Sangre de Cristo Creek; South Park; Pagosa Springs; Empire; Bosworth's range; La Porte; Georgetown; Moon's ranch; Table Rock; Beaver Creek; Tobe Miller's ranch; Walden.

6. *Crepis runcinata* T. & G. In valleys from N. D. and Alb. to Colo.—Westcliffe.

7. *Crepis riparia* A. Nels. On river banks of Neb. and Colo. and Utah.—Yampa; Steamboat Springs.

8. *Crepis denticulata* Rydb. In the mountains of Colo., Wyo. and Utah.—Near Lake John, North Park.

9. *Crepis acuminata* Nutt. On hillsides from Mont. and Wash. to Colo. and Calif.—Alt. 7000-8000 ft.—Van Boxle's ranch, above Cimarron; Middle Park; near Manitou; Deadman Cañon; Mancos.

10. *Crepis intermedia* A. Gray. On hillsides from Mont. and Wash. to Colo. and Calif.—Alt. about 7000 ft.—Big Creek Gulch, Routt Co.; Ragged Mountain, Gunnison Co.; Mancos; Cedar Edge.

11. *Crepis angustata* Rydb. On hillsides from Mont. and Wash. to Colo. and Oregon.—Alt. about 8000 ft.—North Park; Howe's Gulch.

12. *Crepis pumila* Rydb. On hillsides from Mont. and Ida. to Colo. and Calif.—Soda Springs.

13. *Crepis occidentalis* Nutt. On plains and hillsides from Mont. and Wash. to Colo. and Calif.—Alt. 5000-8000 ft.—Denver; Dolores; Thompson's Park, east of Mancos; Boulder; McCoy's, Eagle Co.; Mancos.

14. *Crepis scopulorum* Coville. In the mountains from Mont. to Colo. and Utah.—Alt. about 8000 ft.—Cerro Summit.

15. *Crepis nana* Richardson. Arctic-alpine localities from Lab. to Colo., Calif. and Alaska.—Mt. Lincoln.

11. *HIERACIUM* L. HAWK-WEED.

Achenes cylindrical.

Flowers yellow.

Plant 4-10 dm. high, leafy.

Plant low, 1-3 dm. high, with 1-3 stem-leaves and a few heads.

1. *H. cynosuroides*.

2. *H. gracilis*.

3. *H. albiflorum*.

4. *H. Fendleri*.

Flowers white or ochroleucous.

Achenes tapering gradually upwards.

1. *Hieracium cynosuroides* Arvet. On hillsides and in valleys from Mont. and B. C. to Colo.—Breckenridge.

2. *Hieracium gracile* Hook. In the mountains from Mont. and Alaska to Colo. and Calif., especially along streams.—Alt. 9000-12,000 ft.—Cameron Pass; Chambers' Lake; Caribou; Silver Plume; high mountains about Empire; Gray's Peak; Marshall Pass; Berthoud Pass; above Beaver Creek; bank of Michigan; headwaters of Clear Creek; Anita Peak.

3. *Hieracium albiflorum* Hook. Open woods from Yukon to Colo. and Calif.—Alt. 8000-10,000 ft.—Keblar Pass; Continental Divide, Routt Co.; Steamboat Springs; Mt. Harvard; Cameron Pass; mountain between Sunshine and Ward; Buffalo Pass; mountains near Empire; Fish Creek Falls.

4. *Hieracium Fendleri* Schultz Bip. In woods from the Black Hills of S. D. to N. M. and Ariz.—Alt. 6000-10,000 ft.—Soldier Cañon; Horsetooth Mountain; Upper La Plata River; headwaters of Pass Creek; foot-hills, Larimer Co.; mountain above Little South; headwaters of Clear Creek.

12. *NOTHOCALAIS* Greene.

1. *Nothocalais cuspidata* (Pursh) Greene. (*Troximon cuspidatum* Pursh) On prairies from Ills. and S. D. to Mo. and Colo.—Alt. 4000-8000 ft.—Trinidad; Howe's Gulch; foot-hills, Larimer Co.; hills southeast of La Veta; plains near Denver; South Cheyenne Cañon; New Windsor; Horsetooth Gulch; Colorado City.

13. AGOSERIS Raf.

Beak short, scarcely more than half as long as the body of the achenes, striate throughout.

Leaves decidedly pubescent, even in age.

Outer bracts lanceolate, obtuse.

Outer bracts ovate or ovate-lanceolate, acuminate.

Leaves in age glabrate and glaucous.

Bracts villous-ciliate, at least on the margins.

Inner bracts long-acuminate; plant less than 2 dm. high.

1. *A. pubescens*.

2. *A. maculata*.

3. *A. attenuata*.

Inner bracts merely acute.

Leaves obtuse or acute, entire or rarely toothed.

Outer bracts much broader than the inner, often obtusish; plant generally low and leaves short, obtuse.

4. *A. pumila*.

Outer bracts usually not much broader than the inner; plant 3-5 dm. high; leaves long and acute.

5. *A. scorzoneraefolia*.

Leaves acuminate, more or less pinnatifid, lobed or toothed.

Leaves deeply pinnatifid; flowers turning purplish.

6. *A. agrestis*.

Leaves less deeply pinnatifid; flowers not turning purple.

7. *A. Leontodon*.

Bracts glabrous; involucre if at all hairy, only tomentose at the very base.

Leaves entire or toothed.

Outer bracts oval or ovate, obtusish; leaves 2-3 dm. long, oblanceolate; flowers rose-color.

8. *A. roseata*.

Bracts all linear-lanceolate, acute or acuminate; flowers yellow.

Leaves linear-oblanceolate.

9. *A. glauca*.

Leaves narrowly linear.

10. *A. parviflora*.

Leaves pinnatifid with narrow lobes; flowers yellow, turning purple.

Bracts with loose spreading tips; heads broadly campanulate.

11. *A. rosea*.

Bracts appressed; heads more or less turbinate.

12. *A. laciniata*.

Beak long, about as long as or longer than the body of the achene, scarcely striate at the middle.

Bracts all broad, ovate to elliptical, abruptly acuminate.

13. *A. montana*.

Bracts, at least the inner ones, linear or linear-lanceolate, acute.

Involucre more or less regularly imbricated; beak about equalling the body of the achenes.

Leaves densely pubescent.

Plant low; flowers purple.

14. *A. arachnoidea*.

Plant tall; flowers yellow.

15. *A. elata*.

Leaves glabrous or nearly so.

Flowers reddish-brown or deep orange, changing into purplish.

Bracts with purplish blotches; leaves glaucous.

16. *A. purpurea*.

Bracts not with purplish blotches, if at all purplish only along the mid-rib.

Leaves narrowly linear, glaucous, usually pinnatifid with linear lobes.

17. *A. Greenei*.

Leaves oblanceolate, usually entire, rarely with short broad lobes or teeth.

All bracts narrowly linear and acute.

Plant tall, slender, 3-5 dm. high; leaves erect; heads 2-3 cm. high.

18. *A. gracilens*.

Plant low, 1-3 dm. high; leaves spreading; heads 1.5-2 cm. high.

19. *A. humilis*.

Outer bracts oblong or lanceolate, often obtuse.

20. *A. aurantiaca*.

Flowers light yellow, but often turning pinkish; inner bracts elongated in age.

Involucres 1-1.5 cm. in diameter; plant tall and stout, scarcely glaucous.

15. *A. elata*.

Involucres less than 1 cm. in diameter; plant slender, glaucous.

21. *A. arizonica*.

Involucres of two distinct sets of bracts; the inner narrowly linear, 2 to 3 times as long as the ovate or oval outer ones; beak 3-4 times as long as the body of the achenes.

22. *A. rostrata*.

1. *Agoseris pubescens* Rydb. On hillsides of Wyo. and Colo.—Platte Cañon; Marshall Pass.
2. *Agoseris maculata* Rydb. In the mountains of Colo.—Alt. 10,000-13,000 ft.—Silver Plume; Tennessee Pass.
3. *Agoseris attenuata* Rydb. In the mountains of Colo.—Alt. near 10,000 ft.—Mountains west of North Park.
4. *Agoseris pumila* (Nutt.) Rydb. (*Troximon pumilum* Nutt.) On hills from Mont. to Colo.—Alt. up to 12,300 ft.—Red Mountain; Silver Plume.
5. *Agoseris scorzoneraefolia* (Schrud.) Greene. (*Troximon glaucum dasycephalum* T. & G.) On hillsides from Mont. and Alb. to Colo.—Alt. 4000-8000 ft.—Divide road to Steamboat Springs; Gunnison; Four-mile Hill, Routt Co.; Marshall Pass; Gypsum Creek Cañon.
6. *Agoseris agrestis* Osterh. On hills of Colo.—Alt. 7000-12,000 ft.—Estes Park, Larimer Co.; Ojo; butte, five miles southwest of La Veta; Berthoud Pass.
7. *Agoseris Leontodon* Rydb. On hills from Mont. and S. D. to Colo. and Ariz.—Alt. 7000-10,000 ft.—Georgetown; Cripple Creek road, near Pike's Peak; Van Boxle's ranch, above Cimarron; Marshall Pass; Gunnison; Four-mile Hill; Walton Creek; Bear Creek.
8. *Agoseris roseata* Rydb. On hills in Colo.—Bear River, twenty miles below Steamboat Springs.
9. *Agoseris glauca* (Pursh) Greene. (*Troximon glaucum* Nutt.) On prairies and in meadows from Sask. and Wash. to Colo. and Utah.—Alt. 4000-10,000 ft.—Pitkin; near Teller, North Park; Stove Prairie; Bosworth's ranch; Ruxton Dell; Wahatoya Creek; Mancos; mountains, Larimer Co.; swamp above Beaver Creek; Dolores; Elk River; Conejos River, north of Antonito.
10. *Agoseris parviflora* (Nutt.) Dietr. (*Troximon glaucum parviflorum* A. Gray) In meadows from N. D. and Alb. to Colo.—Alt. 4000-8000 ft.—Chambers' Lake; Gunnison; Parlin; Steamboat Springs; Mt. Harvard; Boulder.
11. *Agoseris rosea* (Nutt.) Dietr. (*Troximon roseum* Nutt.) In valleys of Colo.—Alt. about 8000 ft.—Ojo.
12. *Agoseris laciniata* (Nutt.) Greene. (*Stylosanthus laciniatus* Nutt.; not *Troximon laciniatum* A. Gray) In meadows and valleys from Wyo. and Ida. to Colo. and Calif.—Alt. 5000-9500 ft.—Minturn, Eagle Co.; Cerro Summit; Los Pinos; Durango; Seven Lakes, near Pike's Peak; Grayback mining camps; river bluffs north of La Veta; butte, five miles southwest of La Veta; headwaters of Sangre de Cristo Creek; Boulder.
13. *Agoseris montana* Osterh. In the mountains of Colo. and Wyo.—Alt. 9000-11,500 ft.—Mountains west of North Park, along road to Steamboat Springs; Buffalo Pass; mountainsides near Empire.
14. *Agoseris arachnoidea* Rydb. In valleys of southern Colo.—Alt. 7000-9500 ft.—Grayback mining camps; La Veta.

15. *Agoseris elata* (Nutt.) Greene. (*Troximon Nuttallii* A. Gray) In rich low ground from Mont. and B. C. to Colo. and Calif.—Alt. 7000–10,000 ft.—Glenwood Springs; La Veta; Veta Pass; Cameron Pass; Horsetooth Gulch.

16. *Agoseris purpurea* (A. Gray) Greene. (*Troximon auranthiacum purpureum* A. Gray) In the mountains of Colo. and N. M.—Alt. about 9000 ft.—Table Rock; Minnehaha; near Pagosa Peak; Rogers.

17. *Agoseris Greenei* (A. Gray) Rydb. (*Troximon gracilens Greenei* A. Gray) In meadows from Alb. and B. C. to Colo.—Alt. about 8000 ft.—Minnehaha; Chicken Creek.

18. *Agoseris gracilens* (A. Gray) Greene. (*Troximon gracilens* A. Gray) In meadows and on hillsides from Mont. and B. C. to Colo. and Utah.—Alt. 8000–12,000 ft.—Steamboat Springs; West Indian Creek; Bear River, Routt Co.; Pike's Peak; Bob Creek; mountain near Veta Pass; Red Mountain; between Cheyenne Mountain and Seven Lakes; West Mancos Cañon; Grayback mining camps; Pass Creek; Mt. Harvard; North Fork of Cache la Poudre River; Buffalo Pass; Anita Peak; summit of North Park Range, Routt Co.

19. *Agoseris humilis* Rydb. In the mountains of Colo. and Wyo.—Alt. about 9000 ft.—Ironton Park, nine miles south of Ouray; Breckenridge; Tennessee Pass.

20. *Agoseris aurantiaca* (Hook.) Greene. (*Troximon aurantiacum* Hook.) In mountain meadows and on banks of streams from Mont. and B. C. to Colo.—Alt. 6000–13,000 ft.—Steamboat Springs; Pike's Peak; Tennessee Pass; Delta Co.; near Teller, North Park; Mt. Hesperus; near Ironton, San Juan Co.; Franklin.

21. *Agoseris arizonica* Greene. (*A. elongata* Greene) In the mountains of Colo., N. M. and Ariz.—Alt. 7000–9000 ft.—Grayback mining camps; Black Cañon; near Pagosa Peak; Piedra.

22. *Agoseris rostrata* Rydb. In the mountains of Colo.—Alt. 8000–9000 ft.—Lower Boulder Cañon; mountains between Sunshine and Ward; Bear Creek.

14. **TARAXACUM** Hall. DANDELION, BLOWBALL.

Outer bracts (calyculum) more or less squarrose.

Outer bracts reflexed from the base; leaves deeply runcinate with triangular teeth.

Bracts numerous; leaves broad and the terminal lobe large.

1. *T. Taraxacum*.

Bracts few; leaves narrow and the terminal lobe small.

2. *T. mexicanum*.

Outer bracts or most of them appressed at the base and with spreading or reflexed tips; leaves with short lobes or sinuate.

Bracts conspicuously corniculate; the outer about two-thirds as long as the inner; achenes spinulose-toothed above and tuberculate on some of the ribs to near the base.

3. *T. dumetorum*.

Bracts, at least the outer ones, not corniculate; these about half as long as the inner; achenes merely tuberculate above, smooth below; leaves dark green.

4. *T. leiospermum*.

Outer bracts wholly appressed, short.

Plant not dwarf; scape 5–20 cm. high; involucre 15 mm. high or more.

5. *T. montanum*.

Plant dwarf; scape 2–5 cm. high; involucre 6–8 mm. high and about 5 mm. wide.

6. *T. scopulorum*.

1. *Taraxacum Taraxacum* (L.) Karst. (*T. officinale* Weber.) Around dwellings, in fields and on roadsides from Lab. and Wash. to S. C. and Calif.; naturalized from Europe.—Alt. 4000-7000 ft.—Minturn, Eagle Co.; La Veta; Ft. Collins.

2. *Taraxacum mexicanum* DC. In mountain valleys from Colo. to Mex.—Alt. 7000-9000 ft.—Pass Creek; Ouray; headwaters of Sangre de Cristo Creek; hills southeast of La Veta; along Uncompahgre River, near Ouray.

3. *Taraxacum dumetorum* Greene. (*T. oblancheolatum* A. Nels.) In mountain valleys from Ass. to Colo.—Alt. 7000-10,000 ft.—Columbine; mountain near Veta Pass; Cucharas River, below La Veta; Mancos; Seven Lakes; Ft. Collins; Halfway House, Pike's Peak.

4. *Taraxacum leiospermum* Rydberg. In the mountains of Colo.—Alt. about 10,000 ft.—Tennessee Pass; Seven Lakes; Cripple Creek.

5. *Taraxacum montanum* Nutt. (*T. officinale alpinum* A. Gray, in part) In the mountains from Mont. to Colo.—Alt. about 9500 ft.—Chambers' Lake; source of Leroux; Camp Creek.

6. *Taraxacum scopulorum* (A. Gray) Rydb. (*T. officinale scopulorum* A. Gray) On the higher peaks in damp places from B. C. to Utah, Colo. and Mont.—Alt. 10,000-13,000 ft.—West Spanish Peak; Mt. Hesperus.

15. LACTUCA L. LETTUCE.

Achenes with a slender beak; pappus white.

Outer bracts (calyculum) not more than half as long as the bracts proper; flowers yellow, rarely tinged with blue.

Heads 6-8-flowered; achenes several-nerved, not rugose; leaves spinulose on the ribs.

1. *L. virosa*.

Heads 12-20-flowered; achenes 1-3-nerved, transversely rugose.

2. *L. canadensis*.

Involucres about 1 cm. high.

Involucres 1.5-2 cm. high.

Leaves obovate or oblanceolate in outline with broad lobes, often spinulose on the mid-ribs beneath.

3. *L. ludoviciana*.

Leaves linear or linear-lanceolate in outline, entire or with narrow lobes, never spinulose.

4. *L. graminifolia*.

Outer bracts gradually increasing inwards; a distinct calyculum therefore not evident; flowers blue.

5. *L. pulchella*.

Achenes beakless; pappus tawny or brown.

6. *L. spicata*.

1. *Lactuca virosa* L. In waste places and fields from Me. and N. D. to Ga. and Calif.; introduced from Europe.—Alt. 5000 ft.—Ft. Collins; Poudre flats.

2. *Lactuca canadensis* L. In moist open places from N. S. and Sask. to Fla. and Colo.—Alt. 4000-6500 ft.—La Porte, Larimer Co.; Hotchkiss; gulch west of Soldier Cañon.

3. *Lactuca ludoviciana* DC. River banks and moist places from Minn. and Mont. to Mo. and Tex.—Alt. 4000-8000 ft.—New Windsor; between Sunshine and Ward; Denver.

4. *Lactuca graminifolia* Michx. In rich soil from N. C. and Colo. to Fla. and Ariz.—Alt. up to 7500 ft.—Along the Uncompahgre River, near Ouray.

5. *Lactuca pulchella* DC. In wet meadows from Sask. and Wash. to Mo., N. M. and Calif.—Alt. 4000-8000 ft.—Cucharas Valley, near La Veta; Ft. Collins; Durango; Clear Creek; Gunnison; Parlin, Gunnison Co.; McCoy; Walsenburg; Montrose; Boulder; Gypsum; Table Rock; Fortification, Routt Co.

6. *Lactuca spicata* (Lam.) Hitchk. (*L. leucophaea* A. Gray) In moist ground from Newf. and Man. to N. C. and Colo.—Boulder; Steamboat Springs.

16. **SONCHUS** L. SOW-THISTLE; MILK-THISTLE.

Involucres glandular-pubescent; heads about 25 mm. high.

1. *S. arvensis*.

Involucres glabrous; heads about 15 mm. high.

Auricles of the leaves acute; achenes transversely wrinkled. 2. *S. oleraceus*.

Auricles of the leaves rounded; achenes not transversely wrinkled.

3. *S. asper*.

1. *Sonchus arvensis* L. In fields from Newf. and Minn. to N. J. and Colo.; also on the Pacific Coast; introduced from Europe.—Walsenburg.

2. *Sonchus oleraceus* L. In fields and waste places from N. S. and Wash. to Fla. and Calif.; introduced from Europe.—Alt. 5000 ft.—Ft. Collins.

3. *Sonchus asper* (L.) All. In waste places and fields from N. S. and B. C. to Fla. and Calif.; introduced from Europe.—Alt. 4000-8000 ft.—Along Uncompahgre River, near Ouray; Cerro Summit; Glenwood Springs.

NUMBER OF GENERA AND SPECIES LISTED IN EACH FAMILY AND ORDER

Order.	Family.	Genera.	Species.	Genera.	Species.
Ophioglossales	Ophioglossaceæ	1	3	1	3
Filicales	Polypodiaceæ	14	25	14	25
Salviniales	Marsiliaceæ	1	1	1	1
Equisetales	Equisetaceæ	1	4	1	4
Isoetales	Isoetaceæ	1	2	1	2
Lycopodiales	Lycopodiaceæ	1	1		
	Selaginellaceæ	1	4	2	5
Total PTERIDOPHYTA				20	40
Pinales	Pinaceæ	6	11		
	Juniperaceæ	2	6	8	17
Gnetales	Ephedraceæ	1	3	1	3
Total GYMNOSPERMÆ				9	20
Pandanales	Typhaceæ	1	1		
	Sparganiaceæ	1	4	2	5
Naiadales	Zanichelliaceæ	2	13		
	Naiadaceæ	1	1	3	14
Alismales	Scheuchzeriaceæ	1	2		
	Alismaceæ	2	5	3	7
Hydrocharitales	Elodiaceæ	1	2	1	2
Poales	Poaceæ	70	267		
	Cyperaceæ	8	101	78	368
Arales	Araceæ	1	1		
	Lemnaceæ	1	3	2	4
Xyridales	Commelinaceæ	2	3		
	Pontederiaceæ	1	1	3	4
Liliales	Melanthaceæ	3	6		
	Juncaceæ	2	27		
	Alliaceæ	1	13		
	Liliaceæ	5	6		
	Convallariaceæ	4	8		
	Dracænaceæ	2	4		
	Calochortaceæ	1	3		
	Trilliaceæ	1	1		
	Smilacaceæ	1	1	20	69
Amaryllidales	Ixiaceæ	2	5	2	5
Orchidales	Orchidaceæ	12	24	12	24
Total MONOCOTYLEDONES				126	502
Salicales	Salicaceæ	2	33	2	33
Fagales	Betulaceæ	2	3		
	Corylaceæ	1	1		
	Fagaceæ	1	11	4	15
Urticales	Urticaceæ	2	4		
	Cannabinaceæ	1	1		
	Ulmaceæ	1	1	4	6
Santalales	Loranthaceæ	2	6		
	Santalaceæ	1	1	3	7
Polygonales	Polygonaceæ	7	94	7	94
Chenopodiales	Chenopodiaceæ	14	54		
	Amaranthaceæ	4	11		
	Corrigiolaceæ	1	6		
	Allioniaceæ	5	18		

SUMMARY.

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NUMBER OF GENERA AND SPECIES LISTED IN EACH FAMILY AND ORDER.
(Continued.)

Order.	Family.	Genera.	Species.	Genera.	Species.
	Tetragoniaceæ ...	1	1		
	Portulacaceæ	8	14		
	Alsinaceæ	7	41		
	Caryophyllaceæ ..	3	14	43	159
Ranales	Ceratophyllaceæ ..	1	1		
	Ranunculaceæ	17	92		
	Nymphaeaceæ	1	1		
	Berberidaceæ	2	3	21	97
Papaverales	Papaveraceæ	2	4		
	Fumariaceæ	2	4		
	Brassicaceæ	27	144		
	Capparidaceæ	4	8	35	160
Rosales	Crassulaceæ	4	5		
	Saxifragaceæ	12	28		
	Parnassiaceæ	1	3		
	Hydrangeaceæ	3	5		
	Grossulariaceæ ...	1	12		
	Rosaceæ	21	89		
	Malaceæ	4	14		
	Amygdalaceæ	1	4		
	Mimosaceæ	2	2		
	Cassiaceæ	2	3		
	Fabaceæ	36	185	87	350
Geraniales	Geraniaceæ	2	11		
	Linaceæ	1	7		
	Oxalidaceæ	2	3		
	Zygophyllaceæ	2	3		
	Rutaceæ	2	3	9	27
Polygalales	Polygalaceæ	1	4	1	4
Euphorbiales	Euphorbiaceæ	8	25		
	Callitrichaceæ	1	1	9	26
Sapindales	Limnanthaceæ	1	1		
	Spondiaceæ	2	3		
	Celastraceæ	2	3		
	Aceraceæ	2	4	7	11
Rhamnales	Frangulaceæ	2	6		
	Vitaceæ	2	3	4	9
Malvales	Malvaceæ	7	16	7	16
Hypericales	Elatinaceæ	1	2		
	Frankeniaceæ	1	1		
	Hypericaceæ	1	2		
	Cistaceæ	1	1		
	Violaceæ	2	16	6	22
Opuntiales	Loasaceæ	3	20		
	Cactaceæ	4	23	7	43
Thymeliales	Elæagnaceæ	1	2	1	2
Myrtales	Lythraceæ	2	2		
	Epilobiaceæ	16	62		
	Gunneraceæ	2	2	20	66
Umbellales	Hederaceæ	1	1		
	Cornaceæ	2	3		
	Ammiaceæ	27	58	30	62
Ericales	Monotropaceæ	1	1		
	Pyrolaceæ	3	8		
	Ericaceæ	4	4		
	Vacciniaceæ	1	3	9	16

SUMMARY.

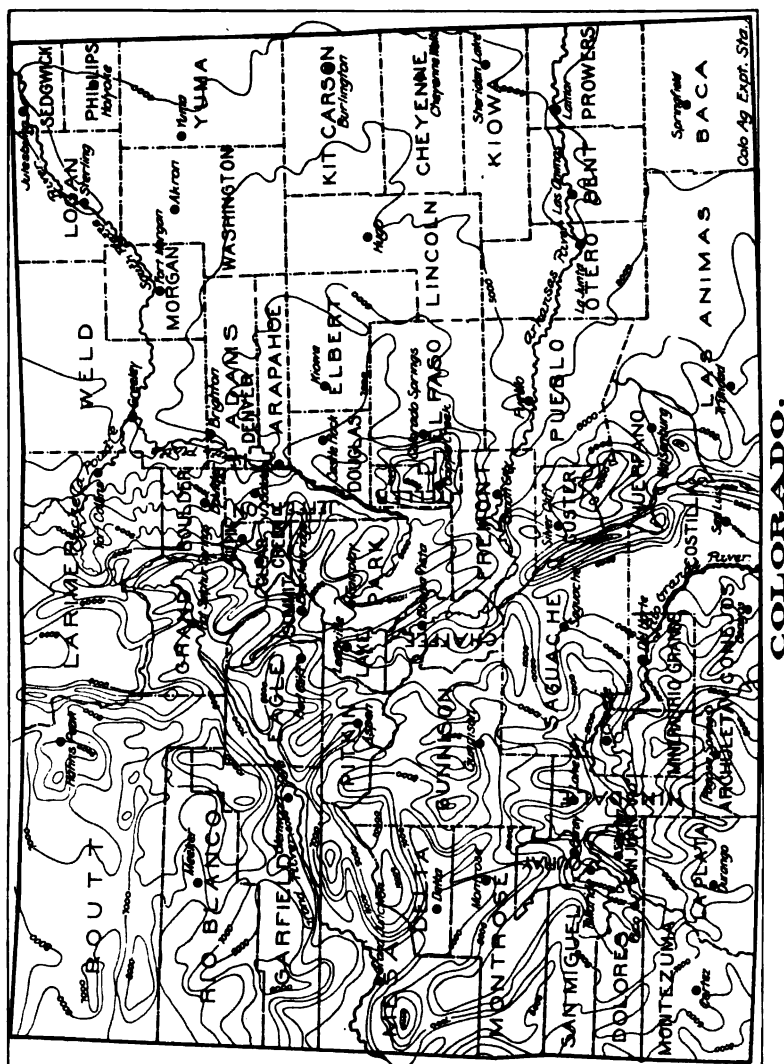
NUMBER OF GENERA AND SPECIES LISTED IN EACH FAMILY AND ORDER
(Continued.)

Order.	Family.	Genera.	Species.	Genera.	Species.
Primulales	Primulaceæ	6	19	6	19
Oleales	Oleaceæ	2	2	2	2
Gentianales	Gentianaceæ	9	26		
	Menyanthaceæ	1	1	10	27
Asclepiadales	Apocynaceæ	2	7		
	Asclepiadaceæ	3	15	5	22
Polemoniales	Cuscutaceæ	1	7		
	Convolvulaceæ	3	8		
	Polemoniaceæ	9	58		
	Hydroleaceæ	5	16		
	Heliotropaceæ	2	2		
	Boraginaceæ	11	76		
	Verbenaceæ	2	6		
	Lamiaceæ	20	38		
	Solanaceæ	9	31		
	Rhinanthaceæ	18	106		
	Pinguiculaceæ	1	2		
	Orobanchaceæ	2	3		
	Martyniaceæ	1	1	84	354
Plantaginales	Plantaginaceæ	1	7	1	7
Rubiales	Rubiaceæ	1	11		
	Caprifoliaceæ	5	14		
	Adoxaceæ	1	1	7	26
Campanulales	Cucurbitaceæ	2	2		
	Campanulaceæ	2	6		
	Lobeliaceæ	1	1	5	9
Valerianales	Valerianaceæ	1	7	1	7
Carduales	Ambrosiaceæ	6	13		
	Carduaceæ	88	568		
	Cichoriaceæ	16	71	110	652
Total DICOTYLEDONES.....				547	2,350

SUMMARY.

	Orders.	Families.	Genera.	Species.
Pteridophyta	6	7	20	40
Spermatophyta:				
Gymnospermæ	2	3	9	20
Angiospermæ:				
Monocotyledones...	10	24	126	502
Dicotyledones	31	100	547	2,350
	49	134	702	2,912

Contour Map of Colorado, Showing Counties, County Seats and Principal Streams.



GAZETTEER OF LOCALITIES MENTIONED GIVING LOCATION AND ELEVATIONS.

The variation of elevation in Colorado from 3,350 to 14,483 feet at the highest peaks, introduces a corresponding range in climate and consequently great differences in flora. Within a short distance there may be a change in elevation which entirely changes the character of the flora, or alters the season of the year. The elevation becomes, therefore, often a more important guide than latitude.

Accordingly pains have been taken to give the elevations of the localities. The names are so often local, frequently changing, that it was thought best to identify them so far as possible, and to give the elevation. This list is therefore not a gazetteer of the State, but intended to give only the localities mentioned in the Flora. Where there are several localities of the same name, as is frequently the case, the ones where collections were made are intended to be given. The extreme elevations of streams are usually given, though not always.

The State has an area of 104,500 square miles, an area nearly as large as the six states of New England and the State of New York in addition. Speaking broadly, the eastern half forms part of the Great Plains. The rise from the eastern border of the State is steady but gentle to the foothills, where there is an abrupt rise, and the remaining half of the State may be considered mountainous, broken by numerous parks. The larger parks, as North Park, Middle Park, South Park and the San Luis Valley, are of considerable size, the latter being nearly 4,000 square miles, and at an elevation of about 7,000 to 8,000 feet. There are many other parks, as Estes Park, Egeria Park, and hundreds of moderate size. In general, timber line is found at about 11,500 feet, variations of 500 feet above or below being found, due to local conditions. The local configuration influences the direction and amount of wind, the upward movement of the air, and consequently the amount and distribution of rainfall, therefore the flora. Hence these elements are important, if not controlling, and necessary to take into consideration. In addition the irrigated sections introduce important modifications. Irrigation occurs principally along the flanks of the mountain ranges, in the mountain valleys, and extending in tongues along the principal streams like the Platte and Arkansas, with small patches in other places where water is available.

The range of climate represents as great extremes as between Charleston, S. C., and Spitzbergen. In parts of the State snow rarely falls nor remains for any length of time, while in the high altitudes snow falls in every month and lasts throughout the year. With these conditions it is not surprising that there is a great number of species.

A map of the State is given showing the contours at intervals of 1,000 feet, all points on the same line being at the same elevation. From this map the general configuration of any part of the State, as well as the elevation of any portion may be closely estimated. The counties as they now exist, the principal streams, and county seats are also shown.

Much more labor was required to identify localities than was anticipated. Collectors have often used names for localities almost impossible to identify, especially where these names depend on ephemeral characters, as the name of an owner. Frequently places have changed names, as South Park was known to Fremont as Bayou Salade. Other names once common are now disused or displaced, and sometimes migrated to other localities.

The elevations are given in most cases, and are hoped to be essentially correct.

L. G. C.

- Alamosa*, Conejos Co., San Luis Valley; alt. 7,550 ft.
Alpine Tunnel, at Alpine Pass, on C. & S. R. R., Chaffee Co.; alt. 11,608 ft.
Anchor, Clear Creek Co.; alt. 10,450 ft.
Andrews' Ranch and
Andrews' Shetland Ranch, on Cache la Poudre; alt. 7,700 ft.
Anita Peak, Elk Head Mountains, Routt Co.; alt. 10,661 ft.
Antonito, station on D. & R. G. R. R., Conejos Co.; alt. 7,888 ft.
Apex, Gilpin Co.; alt. 9,858 ft.
Apishapa River, a tributary of Arkansas River, near Rocky Ford; heads near the Spanish Peaks; alt. from 4,300 to 12,000 ft.
Arapahoe Pass, between Boulder and Grand counties; alt. approx. 12,000 ft.
Arapahoe Peak, Front Range, Boulder Co.; alt. 13,520 ft.
Arboles, station on D. & R. G. R. R., Archuleta Co.; alt. 5,998 ft.
Argentine Pass, between Clear Creek and Summit counties; alt. 13,100 ft.
Arkansas Cañon, commonly restricted to portion above Cañon City; alt. 5,500 to 6,000 ft.
Arkansas Junction, three miles west of Leadville; alt. 10,185 ft.
Arthur's Rock (local), six miles southwest of Fort Collins; alt. 7,000 ft.
Artist's Glen, Pike's Peak; alt. 7,000 to 9,000 ft.
Aspen, Pitkin Co.; alt. 7,874 ft.
Aztec, on Aztec Creek, a tributary to San Juan river. (Some of the plants listed were perhaps collected at Aztec, N. M., which is not far from the Colorado line.)
Badito, on Huerfano River, below Gardner; alt. about 6,500 ft.
Bahia Salada, Spanish name of South Park; see *Bayou Salade*.
Bald Mountain (a very common local name), eight miles west of Loveland; alt. 7,200 ft. See Mt. Baldy.
Baldwin, Gunnison Co., south of Crested Butte; alt. 8,720 ft.
Baltimore, northern Gilpin Co., on Boulder Creek; alt. 8,914 ft.
Bard Creek Valley, near Empire, Clear Creek Co.; alt. 8,300 to 12,000 ft.
Barlow Ranch, Larimer Co., near Livermore; alt. about 6,500 ft.
Barnes' Camp, near junction of Beaver Creek with Little South Poudre; alt. about 7,200 ft.
Basin Creek, tributary to San Miguel in Montrose Co.; alt. 6,000 to 8,000 ft.
Battlement Crag, Pike's Peak; alt. about 9,000 ft.
Baxter's Ranch, west of Fort Collins; alt. 6,500 to 6,800 ft.
Bayfield, see *Los Pinos*.
Bayou Salade, name of South Park by early French trappers; alt. 8,000 to 10,000 ft.
Bear Creek Cañon, near Ouray; alt. 8,722 ft.
Bear Creek (a very common name), near Pike's Peak, enters the Fountain at Colorado City; alt. 5,500 to 12,000 ft.
Bear River, a tributary of Yampa River, Routt Co.; alt. 6,500 to 12,000 ft.
Beaver Creek (a very common name), Larimer Co.; enters Little South; alt. 6,800-11,900 ft.
 Routt Co.; flows into Willow Creek; alt. 8,200-10,000 ft.
 San Miguel Co.; flows into San Miguel River; alt. 7,500 to 12,500 ft.
 Collections were made on all the above streams.
Beaver Park (also common), El Paso and Fremont counties; alt. 9,000 to 10,000 ft.
 Larimer Co., Estes Park, above James's Hotel; alt. 8,500 ft.
 Teller Co., northeast of Cripple Creek; alt. about 9,500 ft.
Bellevue, Larimer Co., eight miles northwest of Fort Collins; alt. 5,211 ft.
Bent's Fort, on Arkansas River, eight miles west of Lamar to 1852. then west of Las Animas; alt. 3,700 to 4,000 ft.
Bergen Park, Jefferson Co., southwest of Golden; alt. 7,643 ft.
Berkeley Lake, Jefferson Co., near Denver; alt. 5,400 ft.
Berthoud Pass, near Georgetown; alt. 11,349 ft.
Berwind, Huerfano Co.; alt. about 6,500 ft.
Bierstadt Lake, near Flat Top trail, Estes Park; alt. about 10,500 ft.
Big Creek Gulch, Routt Co.; alt. about 8,000 ft.

- Big Muddy*, western Gunnison Co.; alt. about 8,000 to 11,000 ft.
Big South, fork of Cache la Poudre; alt. 8,000 to 11,000 ft.
Big Thompson Creek, Larimer Co., from Estes Park to South Platte, near Denver; alt. 4,600 to 12,000 ft.
Bijou Basin, on the plains, El Paso Co., west fork of Bijou Creek, a tributary of South Platte.
Bingham Hill, five miles northwest of Fort Collins; alt. 6,000 ft.
Bitter Creek, Rio Blanco Co., a tributary of White River, below Coyote Basin; alt. 5,800 to 9,000 ft.
Black Cañon of the Gunnison, Gunnison River below Sapinero; alt. about 7,000 ft.
Black's Lake, now forms part of Terry Lake Reservoir, two miles north of Fort Collins; alt. 5,200 ft.
Blue River, a tributary to Grand River, Summit and Grand counties; alt. 7,000 to 12,000 ft.
Bob Creek, west of Mt. Hesperus, La Plata Mountains; alt. 8,000 to 10,000 ft.
Boreas, on Breckenridge Pass, on C. & S. R. R., between Breckenridge and Como; alt. 11,482 ft.
Bosworth's Ranch, Stove Prairie; alt. 8,000 ft.
Bottomless Pit, Pike's Peak; alt. 13,000 ft.
Boulder, Boulder Co.; alt. 5,347 ft.
Boulder Cañon (Lower); alt. about 5,500 ft.
Boulder Creek, Boulder Co., a tributary of the Platte through the St. Vrain; alt. 4,800 to summit of range.
Box Cañon, west of Ouray; alt. 7,000 to 9,000 ft.
Brant's Soda Spring, near North Platte River, Larimer Co.; alt. about 8,800 ft.
Brantly Cañon, Las Animas Co.; alt. about 5,000 ft.
Breckenridge, Summit Co.; alt. about 9,700 ft.
Brush Creek, Custer Co.; alt. 7,000 to 12,000 ft.
Brush Creek, Gunnison Co., tributary to East River; alt. 9,000 to 13,000 ft.
Buckhorn Creek, Larimer Co., a tributary of Big Thompson Creek; alt. about 5,200 to 8,000 ft.
Buena Vista, Chaffee Co., on the Arkansas River; alt. 7,967 ft.
Buffalo Pass, Routt Co. and Larimer Co., across Park Range, between North Platte and Bear Rivers; alt. 10,650 ft.
Cabin Cañon, near Pike's Peak; alt. 5,000 to 10,000 ft.
Cache à la Poudre, now commonly written.
Cache la Poudre River, Larimer Co., outlet of Chamber's Lake, tributary to South Platte River near Greeley; alt. 4,500 to 9,100 ft.
Calhan, El Paso Co., station on the C., R. I. & P. R. R.; alt. 6,508 ft.
Calloway Hill, Larimer Co., near Livermore; alt. about 7,000 ft.
Cameron's Cone, near Pike's Peak; alt. 10,605 ft.
Cameron Pass, Medicine Bow range, between Cache la Poudre and Michigan Creek, Larimer Co.; alt. 10,300 ft.
Camp Creek, North Park; alt. 6,000 to 8,000 ft.
Camp Creek, Routt Co., Buffalo Pass; alt. 6,700 to 10,600 ft.
Camp Creek, south of Gunnison; alt. 7,400 to 10,000 ft.
Camp Hardinge, near Pike's Peak.
Campton's, on the North Poudre, Larimer Co.; alt. about 7,800 ft.
Cañon City, Fremont Co.; alt. 5,343 ft.
Caribou, Boulder Co.; alt. 9,912 ft.
Carisa,
Carriso, in the Navajo settlements; alt. 8,000 to 9,000 ft.
Carlton Lake, Grand Co., near Grand Lake; alt. about 8,100 ft.
Carson, Hinsdale Co., northeastern part (high).
Cascade Cañon, Pike's Peak; alt. 7,409 ft.
Cascade, seven miles west of Colorado Springs, El Paso Co., on Colorado Midland R. R.; alt. 7,000 ft.
Cassell's, northern part of Park Co.; alt. about 9,000 ft.
Castle Cañon, Castle Gulch, east of Jamestown; alt. 6,800 to 8,000 ft.
Castle Rock, Douglas Co.; alt. 6,219 ft.

Cedar Creek, Logan Co., tributary to Horsetail Creek.

Montrose Co., tributary to Uncompahgre River; alt. 6,000 ft.

Cedar Edge (Cedaredge), north central Delta Co.; alt. about 7,000 ft.

Cedar Hills, northern part of Las Animas Co.; alt. about 6,000 ft.

Central City, Gilpin Co., on U. P. D. & G. R. R.; alt. 8,515 ft.

Cerro Summit, Montrose Co., between Cimarron and Montrose; alt. 7,964 ft.

Chamber's Lake, head of Poudre River, Larimer Co.; alt. 9,100 ft.

Cherokee Hill, near Livermore, Larimer Co.; alt. 7,000 to 8,000 ft.

Cherry Creek, tributary of South Platte, near Denver, on Divide between Platte and Arkansas Rivers; alt. 5,000 to 7,700 ft.

Cherry Creek, Montezuma Co., tributary to Rio de la Plata.

Chester, Saguache Co., station on the D. & R. G. R. R., between Salida and Gunnison; alt. 9,397 ft.

Cheyenne Cañon, see North and South Cheyenne Cañons, Pike's Peak; alt. about 6,000 to 9,000 ft.

Cheyenne Mountain, southeast of Pike's Peak; alt. 9,407 ft.

Cheyenne Wells, Cheyenne Co., on the U. P. R. R.; alt. 4,279 ft.

Chicago Lakes, six miles southeast of Georgetown, north slope of Mt. Evans; alt. 11,500 ft.

Chicken Creek, west of La Plata Mountains, Montezuma Co.; alt. 7,000 to 9,000 ft.

Cimarron Creek, see Little Cimarron River; alt. 6,900 to 14,000 ft.

Cimarron River, a tributary of Arkansas River, flowing through southeastern Colorado; alt. about 3,600 to 7,500 ft. Most references are to the Little Cimarron, or Cimarron Creek.

Cimarron Station, on the D. & R. G. R. R., at the junction of the Little Cimarron and the Gunnison; alt. 6,906 ft.

Cipango Hill, Larimer Co., west of Stove Prairie; alt. about 8,000 ft.

Clark's Peak, Larimer Co., near Chamber's Lake; alt. 13,800 ft. Sometimes locally called Cameron Peak from neighboring Cameron Pass.

Clear Creek, a tributary of the South Platte River, at Denver; alt. 5,000 to 12,000 ft. A common name.

Clear Creek Cañon, cañon of Clear Creek, above Golden.

Clear Lake, three miles south of Georgetown; alt. 9,870 ft.

Cochetopa Pass, Saguache Co., between Cochetopa Creek and Saguache River; alt. 10,032 ft.

Coffee Pot Spring, Coffee Pot Gulch, southeast Garfield Co.; alt. above 10,600 ft.

Colorado City, El Paso Co., between Colorado Springs and Manitou; alt. 6,110 ft.

Colorado College, Colorado Springs; alt. about 6,200 ft.

Colorado Springs, El Paso Co., near Pike's Peak; alt. 6,098 ft.

Columbine, Routt Co., near Hahn's Peak; alt. 8,000 ft.

Columbine, Larimer Co., northern part of Estes Park; alt. about 8,000 ft.

Como, Park Co., South Park; alt. 9,787 ft.

Conejos River, a tributary of the Rio Grande del Norte; alt. from 7,300 to summit of range.

Corral Creek, Grand Co., a tributary of the Grand River.

Cottonwood Creek, Fremont Co., a tributary of the Arkansas River.

Cottonwood Creek, near Buena Vista, Chaffee Co. A very common name.

Cottonwood Lake, near Buena Vista; alt. 9,977 ft.

Cowdry, formerly Pinkhampton, North Park; alt. 8,200 ft.

Cozens, near Berthoud Pass, Middle Park.

Craig, Routt Co., on Beaver River; alt. 6,050 ft.

Crags, The, northwest of Pike's Peak; alt. 10,500 ft.

Crested Butte, Gunnison Co.; alt. 8,896 ft.

Cripple Creek Road, Teller Co. (to Colorado Springs); alt. 6,098 to 9,400 ft.

Cripple Creek, Teller Co.; alt. 9,400 ft.

Crow Creek, Weld Co., a plains tributary of South Platte River from north of Cheyenne; alt. 4,500 to 6,000 ft.

Crystal Creek, north of Glen Eyrie, near Manitou; probably 6,000 to 8,000 ft.

Crystal Creek, near Ouray; alt. 7,000 to 9,000 ft.

- Crystal Park*, between Manitou and Bear Creek Cañon; alt. about 8,500 ft.
Cucharas River, a tributary of Huerfano River; alt. 5,100 to summit of range.
Cumberland Mine, east La Plata Mountains; alt. about 12,300 ft.
Cumbres, Conejos Co., on the D. & R. G. R. R., between Alamosa and Durango at the summit of the San Juan Range; alt. 10,015 ft.
Custer Butte; alt. about 9,000 ft.
Dale Creek, northern Larimer Co.; alt. 7,500 ft.
Damfino Creek, tributary of Encampment Creek, northwest North Park; alt. about 10,000 ft.
Dark Cañon, near Pike's Peak.
Dark Cañon, Gunnison Co., south of Ragged Mountain; alt. 8,500 ft.
Dead Lake, Pike's Peak, on divide between Beaver and Bear Creeks, southeast of summit; alt. 10,800 ft.
Deadman's Cañon, south of Cheyenne Mountain; alt. about 6,500 ft.
Deep Creek Lake, Garfield Co.; alt. about 10,000 ft.
Deep Creek Lake, Routt Co.; alt. about 9,000 ft.
Deep Creek, Routt Co., a tributary of Williams' Fork of Yampa River.
Deep Creek, San Juan Co.; alt. 10,000 to 12,500 ft.
Deer River; alt. about 4,700 ft.
Deer Creek, exceedingly common name.
Deer Run, Mesa Co., station on D. & R. G. R. R. between Delta and Grand Junction; alt. 4,697 ft.
Delta, near mouth of Uncompahgre River; alt. 4,980 ft.
Democrat Mountain, northwest of Georgetown; alt. 11,400 ft.
Denver, alt. 5,198 ft.
Devil's Causeway, on the headwaters of Yampa River; alt. 6,182 ft.
Dillon Cañon, Trinidad Co.; alt. about 7,000 ft.
Dillon, Summit Co.; alt. 8,859 ft.
Dix, La Plata Co.; alt. 7,500 ft.
Dixon Cañon, near Fort Collins; alt. 5,500 to 6,500 ft.
Dolores, Montezuma Co.; alt. 6,957 ft.
Dome Rock, Platte Cañon; alt. 6,211 ft.
Dome Rock Valley, near Platte Cañon; alt. about 6,000 ft.
Douglas Mountain, Clear Creek Co.; alt. 9,552 ft.
Doyle, Gunnison Co., station on D. & R. G. R. R.; alt. 8,047 ft.
Doyle's Ranch, on Huerfano River; alt. 4,715 ft.
Dry Creek, Larimer Co.; alt. 5,000 to 7,000 ft. Locally applied to any intermittent stream with storm flow. Very common.
Dumont, Clear Creek Co., between Georgetown and Idaho Springs; alt. 7,938 ft.
Durango, La Plata Co.; alt. 6,520 ft.
Eads, Kiowa Co., on the Mo. Pac. R. R.; alt. 4,707 ft.
Eagle Cliff, head of Park Hill, Estes Park, Larimer Co.; alt. 8,300 ft.
Eagle River, a tributary of the Grand; alt. 6,100 to 10,000 ft.
East Indian Creek, a tributary of Cucharas River, Huerfano Co.; alt. 7,000 to 10,500 ft.
East River, Gunnison Co., a tributary of Taylor River.
East River, Teller Co.
Echo Cañon, Lake Co., west of Twin Lakes; alt. about 10,000 ft.
Echo Creek, near La Veta, a tributary of Cucharas River.
Echo Creek, west of La Plata Mountains; alt. 9,500 to 11,000 ft.
Egeria Park, on Egeria Creek, Routt Co.; alt. 8,000 to 10,000 ft.
Eldora, Boulder Co.; alt. 8,543 ft.
Elizabeth, Elbert Co.; alt. 6,300 ft.
Elk Cañon, on Elk River, Routt Co.; alt. 8,000 ft.
Elk River, Routt Co., a tributary of Bear River.
El Late, see Sierra el Late, Montezuma Co.; alt. 9,840 ft.
Empire, Clear Creek Co.; alt. 8,603 ft.
Empire Pass, between Georgetown and Empire; alt. about same as Empire.
Encampment Meadow, northwest of North Park, on Grand Encampment Creek; alt. 8,171 ft.

- Engelmann Cañon*, near Pike's Peak; alt. about 8,000 ft.
Engineer Mountain, San Juan Co.; alt. 13,190 ft.
Estes Park, Larimer Co.; alt. 7,500 and upward to 8,500 ft.
Ethel Peak, Larimer Co., Park Range; alt. 11,976 ft.
Fish Creek, North Park, Larimer Co.; also near Virginia Dale, Larimer Co.
Fish Creek, Routt Co., a tributary of Bear River. Common name.
Fish Creek Falls, on Fish Creek, Routt Co.; alt. about 9,000 ft.
Flat Top Mountain, Routt Co., also west of Estes Park; alt. 13,000 ft.
Floral Mountain, northeast of Berthoud Pass; alt. 12,378 ft.
Florence, Fremont Co., on the Arkansas River; alt. 5,199 ft.
Florissant, Teller Co.; alt. 8,177 ft.
Fontaine qui Bouille River, tributary of Arkansas, at Pueblo; alt. 4,700 to 9,000 ft.
Fontaine qui Bouille Valley, from Colorado Springs south to Pueblo; alt. 4,600 to 6,000 ft.
Forester's Ranch, Larimer Co., on La Garde Creek, near Wyoming line; alt. 7,500 ft.
Fort Collins, Larimer Co.; alt. (Agr'l. College) 4,994 ft.
Fort Garland, San Luis Valley; alt. 7,937 ft.
Fortification Peak, near Craig, Routt Co.; alt. 7,668 ft.
Fort Lyon (near Las Animas), Bent Co.; alt. about 3,910 ft.
Fort Morgan, Morgan Co.; alt. 4,319 ft.
Fossil Beds, Fremont Co., south of Cripple Creek; alt. 6,000 ft.
Fossil Creek, Larimer Co., four miles south of Fort Collins; alt. 4,800 to 6,000 ft.
Four-Mile Hill, Routt Co., near Four-Mile Creek; alt. 7,500 to 9,000 ft.
Franklin, Las Animas Co., north of Trinidad; alt. 6,272 ft.
Garden of the Gods, north of Manitou; alt. 6,500 to 7,000 ft.
Gardner, Huerfano Co., on Huerfano River; alt. about 7,000 ft.
Garland, five miles from Fort Garland, Costilla Co.; alt. 8,112 ft.
Gato, on D. & N. W. R. R., Boulder Co.; alt. 8,000 ft.
Gato Creek, west side San Luis Valley, Conejos Co.; alt. 8,000 to 10,000 ft.
Gentian Ridge, Pike's Peak.
Georgetown, Clear Creek Co.; alt. 8,488 ft.
Gibbs' Peak, Custer Co.; alt. 12,200 ft.
Glen Eyrie, five miles from Manitou, north of Garden of Gods; alt. about 6,500 ft.
Glen Mountain Falls, near Pike's Peak.
Glenwood Springs, Garfield Co.; alt. 5,758 ft.
Golden, Jefferson Co., on Clear Creek; alt. 5,667 ft.
Goose Creek, Mineral Co., tributary to Rio Grande; alt. about 9,000 ft.
Gore Pass, across Gore Mountains, border between Grand and Routt Co. east of Egeria Park; alt. about 9,600 ft.
Graham's Park, on D. & R. G. R. R.; alt. 10,605 ft.
Granada, Prowers Co.; alt. 3,493 ft.
Grand Cañon, Cañon of the Arkansas River; alt. 5,500 to 6,000 ft.
Grand Lake, Middle Park; alt. 8,153 ft.
Grand Mesa, table land between Mesa and Delta counties; alt. 9,000 to 10,000 ft.
Grand Junction, Mesa Co., on Grand River, at the junction of the Gunnison; alt. 4,594 ft.
Grand River, the principal river of western Colorado, forming, with the Green, the Colorado River of the West; alt. 4,500 to 11,000 ft.
Granite, station on the D. & R. G. R. R., in Chaffee Co.; alt. 8,930 ft.
Grant Lake (probably Clear Lake, south of Georgetown).
Grayback Mining Camps, near Grayback, Sangre de Cristo Range, east of Sierra Blanca; alt. 9,000 to 10,000 ft.
Graymont, Clear Creek Co.; alt. 9,783 ft.
Gray's Peak, Front Range, Clear Creek Co.; alt. 14,341 ft.
Grecian Bend, Pike's Peak.
Greeley, Weld Co., on Poudre River; alt. about 4,600 ft.

- Green*, North Park; alt. 8,200 ft.
Greenhorn Mountains, Pueblo and Huerfano counties; alt. 12,340 ft.
Green Mountain Falls, on the Midland R. R., El Paso Co., northwest of Pike's Peak; alt. 7,700 ft.
Green River, northwest Colorado, unites with the Grand; alt. in Colorado about 5,000 ft.
Gregory Cañon (Gregorio River, San Luis); alt. 8,500 ft.
Grizzly Creek, Larimer Co., in North Park, a tributary of the North Platte; alt. 9,500 ft.
Grizzly Creek, also five miles up the Grand from Glenwood Springs.
Grizzly Gulch, west side North Park; alt. about 8,500 ft.
Gunnison, Gunnison Co.; alt. 7,683 ft.
Gypsum, Eagle Co., station on D. & R. G. R. R.; alt. 6,310 ft.
Gypsum Creek Cañon, Eagle Co., a tributary of Eagle River; alt. about 6,000 ft.
Halfmoon Creek, Lake Co., a tributary of the Arkansas River, southwest of Leadville; alt. 9,600 to 12,000 ft.
Halfway House, on Pike's Peak Cog Road; alt. 8,400 ft.
Hamor's Lake, north of Durango; alt. about 9,000 ft.
Hahn's Peak, Park Range, Routt Co.; alt. 10,906 ft.
Happy Hollow, fifteen miles west of Fort Collins; alt. about 6,500 ft.
Hardin's Ranch, north of Manhattan, Larimer Co.; alt. about 7,800 ft.
Hayden, Routt Co.; alt. 7,500 ft.
Hayden's Ranch, Lake Co., station on the D. & R. G. R. R.; alt. 9,141 ft.
Hebron, Larimer Co., North Park; alt. 8,200 ft.
Hematite (Hematite Gulch, San Juan Co., east of Silverton); alt. 10,000 to 12,500 ft.
Hermosa, La Plata Co., between Durango and Silverton; alt. 6,630 ft.
Hill's Ranch, McElmo Creek, Montezuma Co.; alt. 5,000 to 8,000 ft.
Higbo, Larimer Co., near Lake John, North Park.
Holdredge Meadow, or Ranch, on Michigan River, North Park; alt. about 8,400 ft.
Home P. O., Zimmerman's Ranch, Larimer Co., on Cache la Poudre; alt. about 7,500 ft.
Honnold, Routt Co., on Little Snake River, near Wyoming line; alt. 9,158 ft.
Horseshoe Mountain, Summit Co., southeast of Leadville; alt. 13,912 ft.
Horsetooth Gulch, near Horsetooth Mountain; alt. 5,500 to 6,500 ft.
Horsetooth Mountain, seven miles southwest of Fort Collins; alt. 7,160 ft.
Hortense Springs, Chaffee Co., near Mt. Princeton; alt. 7,700 ft.
Hotchkiss, Delta Co., between Delta and Paonia; alt. 5,369 ft.
Hot Sulphur Springs, Grand Co., Middle Park; alt. 7,800 ft.
Hovenweep Cañon, Montezuma Co., cañon of Yellow Jacket or Hovenweep Creek; alt. 6,300 ft.
Hovenweep Castle, Montezuma Co.; alt. 5,239 ft.
Howe's Gulch, Larimer Co., west of Fort Collins; alt. 5,500 to 7,000 ft.
Hubbard Creek, Delta Co.
Huerfano, Huerfano Co., on Huerfano River; alt. 5,662 ft.
Huerfano Valley, upper part of Huerfano River, between the Greenhorn Mountains and the Sangre de Cristo Range; alt. about 8,300 ft.
Hughes' Lake, Ouray Co.; alt. 7,500 ft.
Hugo, Lincoln Co.; alt. 5,068 ft.
Idaho Springs, Clear Creek Co.; alt. 7,550 ft.
Ignacio, La Plata Co.; alt. 6,437 ft.
Indian Creek Pass, Culebra Range, from East Indian Creek to West Indian Creek; alt. 9,803 ft.
Iola, Gunnison Co., station on D. & R. G. R. R.; alt. 7,434 ft.
Iron Mountain, east of Sierra Blanca, Huerfano Co.; alt. 11,000 ft.
Ironton Park, nine miles south of Ouray; alt. about 9,500 ft.
Ivywild, Pike's Peak Cog Road; alt. about 7,500 ft.
Jack Brook, Pike's Peak; alt. 8,500 to 10,000 ft.
Jack's Cabin, Gunnison watershed, station on D. & R. G. R. R., between Gunnison and Crested Butte; alt. 8,294 ft.

- James' Peak*, Gilpin Co., Front Range; alt. 13,283 ft. (Name originally given to Pike's Peak.)
- Jefferson*, Park Co., South Park; alt. 9,502 ft.
- Johnston Cañon*, Mesa Verde, near Mancos River; alt. 4,000 to 8,000 ft.
- Julesburg*, Sedgwick Co., on South Platte River; alt. 3,458 ft.
- Kebler Pass*, Gunnison Co.; alt. about 10,000 ft.
- Kelso Mountain*, southwest of Georgetown; alt. 13,423 ft.
- Kendall Basin*, near Silverton.
- Kremmling*, Grand Co., near Grand River; alt. 7,150 ft.
- Lafayette*, Boulder Co.; alt. 5,300 ft.
- Lake City*, Hinsdale Co.; alt. 8,686 ft.
- Lake John*, North Park; alt. 8,200 ft.
- Lake Moraine*, on Ruxton Creek, Pike's Peak, east of summit; alt. 10,268 ft.
- Lamar*, Prowers Co., on Arkansas River; alt. 3,592 ft.
- Lamb's Ranch*, now Mills's, Long's Peak Inn, near Long's Peak; alt. 9,100 ft.
- La Plata Mountains*, Montezuma Co. and La Plata Co.; alt. up to 14,342 ft.
- La Plata Peak*, Saguache Range, Chaffee Co.; alt. 14,302 ft.
- La Plata River*, Montezuma Co., a tributary of the San Juan; alt. 4,700 to 13,000 ft.
- La Porte*, six miles northwest of Fort Collins; alt. about 5,200 ft.
- Laramie Plains*, between Big Laramie River and Poudre tributaries; alt. 7,000 to 9,000 ft.
- Laramie River*, Larimer Co.; alt. (from Wyoming line to Clark's Peak) 7,500 to 10,000 ft.
- La Pagosa*, see Pagosa Springs.
- La Salle*, Weld Co., on South Platte River; alt. 4,665 ft.
- Las Animas Perdidas*, La Plata Co., a tributary of the San Juan.
- Las Animas Cañon*, cañon of Rio de las Animas; alt. 11,000 ft.
- La Veta*, Huerfano Co., on Cucharas River; alt. 7,024 ft.
- Leadville*, Lake Co.; alt. 10,200 ft.
- Lee's Lake*, three miles west of Fort Collins; alt. 5,100 ft.
- Leroux Creek*, Delta Co., flows into North Fork of Gunnison River; alt. 5,300 to 11,000 ft.
- Leroux Park*, Delta Co.; alt. 5,300 to 8,000 ft.
- Little Beaver Creek*, Larimer Co., flows into South Fork of Poudre River; alt. 8,000 ft.
- Little Cimarron River*, flows into the Gunnison River; alt. 6,900 to 14,000 ft.
- Little Kate Basin*, Basin Creek; alt. about 10,500 ft.
- Little Kate Mine*, La Plata Mountains; alt. about same as above.
- Little South*, a tributary of the Cache la Poudre, below the Rustic, Larimer Co.; alt. 6,500 to 11,000 ft.
- Little Veta Mountains*, west of Veta Mountain, Huerfano Co.; alt. about 10,000 ft.
- Livermore*, Larimer Co., on North Poudre; alt. 6,000 ft.
- Lone Pine Creek*, Larimer Co., tributary of North Poudre; alt. 6,000 to 9,000 ft.
- Long Gulch*, Larimer Co.; also Boulder Co., on the St. Vrain; a frequent name; alt. about 7,500 ft.
- Longmont*, Boulder Co.; alt. 4,947 ft.
- Long's Peak*, Front Range, between Boulder and Larimer counties; alt. 14,271 ft.
- Los Pinos*, Conejos Co., on D. & R. G. R. R.; alt. 9,622 ft.
- Loveland*, Larimer Co., on Big Thompson; alt. 4,984 ft.
- Lulu Pass*, Larimer Co., east of Mt. Richtofen; alt. about 12,000 ft.
- Lyons*, Boulder Co.; alt. about 6,500 ft.
- McCoy*, Eagle Co., on Grand River; alt. about 8,000 ft.
- McElmo Cañon*, Montezuma Co., Cañon of McElmo Creek, a tributary of San Juan River; alt. of creek at head, 7,000 ft.; at mouth, 4,566 ft.
- McIntyre Creek*, Larimer Co.; alt. 7,000 to 10,000 ft.
- Mancos*, Montezuma Co.; alt. 7,008 ft.
- Manitou*, east base of Pike's Peak; alt. 6,318 ft.

- Marshall Pass*, D. & R. G. R. R., between the Arkansas and Gunnison watersheds; alt. 10,856 ft.
- Mason's River Front Farm*, near Fort Collins, Larimer Co.; alt. about 5,000 ft.
- Massif de l'Arapahoe*, Arapahoe Peak; alt. 13,520 ft.
- Meadow Park*, near Lyons, Boulder Co.; alt. about 6,500 ft.
- Medicine Bow Mountains*, range east of North Park, Larimer Co. Highest peak is Clark's Peak; alt. 13,800 ft.
- Meeker*, Rio Blanco Co.; alt. 6,182 ft.
- Mesa Verde*, Montezuma Co., table land; alt. 6,500 to 8,500 ft.
- Michigan River*, North Park, a tributary of the North Platte River; alt. 8,000 to 11,000 ft.
- Middle Park*, between the Front Range and Park Range and drained by Grand River.
- Miller's Ranch*, see Tobe Miller; alt. about 5,300 ft.
- Minnehaha*, on Ruxton Creek, near Pike's Peak; alt. about 8,400 ft.
- Minturn*, Eagle Co., station on D. & R. G. R. R.; alt. 7,825 ft.
- Montclair*, Arapahoe Co., Denver suburb; alt. 5,400 ft.
- Monte Vista*, Rio Grande Co., San Luis Valley; alt. 7,665 ft.
- Montezuma*, Summit Co.; alt. 10,295 ft.
- Montrose*, Montrose Co., on Uncompahgre River; alt. 5,811 ft.
- Monument*, station on D. & R. G. R. R., El Paso Co.; alt. 6,974 ft.
- Monument Park*, El Paso Co., near Edgerton Station; alt. about 8,000 ft.
- Moon's Ranch*, west of Fort Collins; alt. 7,500 ft.
- Moraine*, Sprague's, Estes Park; alt. 8,000 ft.
- Morrison*, Jefferson Co., on Bear Creek; alt. 5,765 ft.
- Mosquito Pass*, east of Leadville; alt. 13,700 ft.
- Mt. Abram*, near Ouray; alt. 12,790 ft.
- Mountain View*, on Pike's Peak Cog Road; alt. about 10,000 ft.
- Mt. Antero*, Saguache Range, Chaffee Co.; alt. 14,245 ft.
- Mt. Baldy*, or *Bald Mountain* (a common local name), Larimer Co., west of Loveland; alt. 7,000 ft.
- Larimer Co., east of Laramie River; alt. 11,250 ft.
- Boulder Co.; alt. 11,470 ft.
- Delta Co.; alt. 10,632 ft.
- Near Pike's Peak; alt. about 12,300 ft.
- Sangre de Cristo Range, near Sierra Blanca; alt. 14,176 ft.
- Mt. Bartlett*, Park Range, Summit Co.; alt. about 13,500 ft.
- Mt. Bross*, Middle Park, Park Range; alt. 14,100 ft.
- Mt. Elbert*, Saguache Range, Lake Co.; alt. 14,436 ft.
- Mt. Evans*, west of Denver; alt. 14,260 ft.
- Mt. Garfield*, near Pike's Peak; alt. 13,500 ft.
- Mt. Harvard*, Saguache Range, Chaffee Co.; alt. 14,375 ft.
- Mt. Hayden*, near Ouray; alt. 13,100 ft.
- Mt. Hesperus*, La Plata Mountains, Montezuma Co.; alt. 13,376 ft.
- Mt. La Plata*, or *La Plata Peak*, Saguache Range, Chaffee Co.; alt. 14,302 ft.
- Mt. Lincoln*, Park Range, Park Co.; alt. 14,297 ft.
- Mt. McClellan*, Front Range, near Gray's Peak; alt. 13,423 ft.
- Mt. Massive*, Saguache Range, Lake Co.; alt. 14,271 ft.
- Mt. Ouray*, Saguache Range, Chaffee Co.; alt. 14,055 ft.
- Mt. Princeton*, Saguache Range, Chaffee Co.; alt. 14,199 ft.
- Mt. Richthofen*, Medicine Bow Range, south of Cameron Pass, Larimer Co.; alt. about 13,800 ft.
- Mt. Robinson*, Summit Co., near Robinson; alt. 10,760 ft.
- Muddy River*, Middle Park, flows into Grand River; alt. 7,100 to 9,000 ft.
- Narrows*, Cache la Poudre River, Larimer Co.; alt. about 6,500 ft. Name given to a short box cañon.
- Navajo Cañon*, on Navajo Creek, a tributary of the Huerfano River; alt. 8,600 ft.
- Nepesta*, Pueblo Co., on Arkansas River; alt. 4,394 ft.
- New Castle*, Garfield Co., on Grand River; alt. 5,562 ft.
- New Windsor*, western Weld Co.; alt. 4,800 ft.

- North Cheyenne Cañon*, foot of Cheyenne Mountain, east of Pike's Peak; alt. 6,000 to 11,000 ft.
- North Park*, between Park Range and Medicine Bow Range, drained by North Platte River; alt. 8,000 to 9,000 ft.
- North Park Range*, between Larimer and Routt counties.
- Notch Mountain*, part of Mt. Richtofen; alt. about 13,000 ft.
- Also near Mt. of the Holy Cross.
- Oak Mesa*, Delta Co.
- Ojo*, at the foot of Veta Mountain, Huerfano Co.; alt. about 8,000 ft.
- Olathe*, Montrose Co.; alt. 5,352 ft.
- Oro City*, southeast of Leadville; alt. about 10,800 ft.
- Ouray*, Ouray Co.; alt. 7,721 ft.
- Owl Cañon*, Cañon of Owl Creek, North Park.
- Also at head of Hook and Moore Glade, near Fort Collins; alt. about 5,600 ft.
- Pagosa Peak*, San Juan Range, Mineral Co.; alt. 12,674 ft.
- Pagosa Springs*, Archuleta Co.; alt. 7,108 ft.
- Palisade*, Mesa Co.; alt. about 4,723 ft.
- Pallas*, near southeast corner of Routt Co., on Bear River; alt. 8,700 ft.
- Palmer Lake*, summit of Divide between Arkansas and South Platte watershed, El Paso Co.; alt. 7,237 ft.
- Palsgrove Cañon*; alt. about 9,000 ft.
- Pandora*, San Miguel Co., southeast of Telluride; alt. 9,000 ft.
- Paonia*, Delta Co., on North Fork of Gunnison River; alt. about 5,500 ft.
- Park Range*, west of North Park; also divide between South Park and Arkansas River.
- Parlin*, Gunnison Co., between Marshall Pass and Gunnison; alt. 7,937 ft.
- Parrott City*, La Plata Co., between Durango and Mancos; alt. 8,633 ft.
- Pass Butte*, near southeast corner Routt Co.; alt. 8,265.
- Pass Creek*, near Veta Pass; alt. from 7,000 to 9,000 ft.
- Pass Creek*, Saguache Co., flows into Cochetopa Creek; alt. 8,000 to 10,000 ft.
- Paxton Ranch*, near Mancos; alt. about 7,000 ft.
- Pearl*, North Park; alt. about 8,500 ft.
- Pennock's* (Pennock's Ranch), about eight miles west of Fort Collins; alt. about 5,500 ft.
- Pennock's Mountain Ranch*, off Rist Cañon Road; alt. about 8,000 ft.
- Penn's Gulch* (Pennsylvania Gulch) (?), east of Georgetown.
- Peoria Creek*; alt. about 6,000 ft.
- Piedra*, Archuleta Co., on Rio Piedra; alt. 6,520 ft.
- Pike's Peak*, El Paso Co.; alt. 14,108 ft.
- Pine Grove*, on South Platte, Douglass Co.; alt. 6,738 ft.
- Piney Creek*, Eagle Co., a tributary of Eagle River; alt. about 7,500 ft.
- Pingree Hill*, Larimer Co., near Manhattan; alt. 7,000 to 8,200 ft.
- Pinkham Creek*, Larimer Co., North Park; alt. 8,400 ft.
- Pinkhampton* (now Cowdry), Larimer Co., North Park; alt. 8,400 ft.
- Pitkin*, Gunnison Co.; alt. 9,192 ft.
- Placer*, Costilla Co., on Sangre de Cristo Creek; alt. about 8,000 ft.
- Pleasant Valley*, northeast of Greeley; alt. 4,800 ft.
- Pleasant Valley*, also northwest of Fort Collins; alt. about 5,200 ft.
- Poncha Pass*, between the Arkansas River and the San Luis River, D. & R. G. R. R.; alt. 8,945 ft.
- Porter*, La Plata Co., near Durango; alt. 7,009 ft.
- Poudre Cañon*, Cañon of Cache la Poudre River, Larimer Co.; alt. 6,000 to 7,000 ft.
- Poudre River*, see Cache la Poudre River.
- Poverty Ridge*, near Cimarron; alt. about 8,500 ft.
- Pueblo*, Pueblo Co.; alt. 4,672 ft.
- Purgatoire*, or *Purgatory River*, or Las Animas River, a tributary of the Arkansas River, Las Animas, Otero and Bent counties; alt. 3,800 to 6,000 ft.
- Quail Creek*, near Steven's Mine, Graymont, Clear Creek Co.; alt. up to 11,000 ft.

- Queen's Cañon*, near William's Cañon, Manitou.
Quimby, Arapahoe Co., north of Denver; alt. about 5,000 ft.
Rabbit Ear Pass; alt. about 9,000 ft.
Rabbit Ear Range, portion of Continental Divide, south of North Park.
Rabbit Ears, peaks southwest part North Park, Larimer Co.; alt. 10,719 ft.
Ragged Mountain, Gunnison Co.; alt. 11,700 ft.
Raton Mountains, southeast of Trinidad; alt. 9,600 ft.
Recapture Creek, Montezuma Co.; alt. 4,446 ft. at mouth.
Redcliff, Eagle Co.; alt. 8,608 ft.
Red Dirt Divide (near Middle Park), Routt Co.; alt. about 8,000 ft.
Red Mountain, south of Ouray; alt. 12,865 ft.
Red Mountain Road, south of Ouray; alt. 8,000 to 12,300 ft.
Red River, northern part Larimer Co., near Laramie River; alt. 7,100 ft.
Red Rock Cañon, Las Animas Co.; alt. 5,000 ft.
Red Rock Cañon, Dolores River; alt. 6,900 to 8,700 ft.
Red Rock Cañon, near Pike's Peak; alt. 4,000 to 9,000 ft.
Redstone, Larimer Co.; alt. 5,500 to 6,000 ft.
Redstone, Pitkin Co., near Carbondale.
Rico, Dolores Co.; alt. 8,737 ft.
Ridgeway, or *Ridgway*, Ouray Co.; alt. 7,500 ft.
Rifle, Garfield Co.; alt. 5,310 ft.
Rio Blanco, Archuleta Co., flows into the San Juan; alt. 7,500 to 11,500 ft.
Rio Florido, La Plata Co.; alt. 6,100 to 11,000 ft.
Rio Grande, or *Rio Grande del Norte*, rises in San Juan Mountains; alt. in Colorado, 7,300 to 12,400 ft.
Rist Cañon, west of Fort Collins; alt. 5,000 to 6,800 ft.
Roaring Fork, Larimer Co., flows into Cache la Poudre; alt. 7,800 to 10,000 ft.
Robinson, Summit Co., near Fremont Pass; Fremont Pass is alt. 11,330 ft.
Robinson, Bent Co.; alt. 4,007 ft.
Rocky Ford, Otero Co.; alt. 4,180 ft.
Rogers, Rogers Mesa, Gunnison Co., station between Crested Butte and Florence.
 Also station between Delta and Paonia; alt. 5,443 ft.
Roubideau Pass, northwest of Sangre de Cristo Pass, from Huerfano Park to San Luis Valley; alt. about 8,000 ft.
Rosita, Custer Co.; alt. 8,500 ft.
Roswell, El Paso Co., north of Colorado Springs; alt. 6,073 ft.
Royal Gorge, narrowest and deepest part of the Cañon of the Arkansas River; alt. 5,500 to 6,000 ft.
Ruby, Gunnison Co., above Crested Butte; alt. 10,500 ft.
Ruby, Mesa Co., west of Grand Junction; alt. about 4,500 ft.
Rustic, Larimer Co., on the Poudre, foot of Pingree Hill; alt. 7,000 ft.
Ruxton Dell, on Ruxton Creek, Pike's Peak; alt. about 9,000 ft.
Ruxton Park, on Ruxton Creek, Pike's Peak; alt. about 9,000 ft.
Ruxton Ridge, Pike's Peak; alt. about 9,000 ft.
Saddle, on Pike's Peak Cog Road; alt. 13,000 ft.
Saddle Mountain, Park Co.; alt. 10,815 ft.
Saguache, Saguache Co.; alt. 7,723 ft.
Saguache Creek, or *River*, a tributary of San Luis River, Saguache Co.; alt. 7,500 to 13,000 ft.
Saguache Range, separating the Arkansas from the Grand River and Gunnison watersheds; extending from Tennessee Pass to near Salida; alt. to 14,400 ft.
Salida, Chaffee Co.; alt. 7,050 ft.
Sand Creek Pass, Larimer Co., between North Park and Laramie watersheds; alt. about 7,400 ft.
Sangre de Cristo Creek, a tributary of Trinchera River, Costilla Co., near Veta Pass; alt. about 9,000 ft.
Sangre de Cristo Range, separates San Luis Valley from Arkansas Valley; alt. to 14,400 ft.
San Juan Pass; alt. 12,000 ft.

- San Juan Valley*, Montezuma Co.
San Luis Valley, around San Luis River and the upper Rio Grande; alt. 7,500 to 8,000 ft.
Sapinero, Gunnison Co., between Gunnison and Montrose; alt. 7,240 ft.
Sargent's, Saguache Co., on D. & R. G. R. R., between Marshall Pass and Gunnison; alt. 8,462 ft.
Seven Lakes, near Pike's Peak; alt. 10,800 ft.
Sheep Creek, Larimer Co., empties into North Fork Cache la Poudre; alt. about 8,500 ft.
Sheephorn Divide, southwest of Middle Park; alt. 6,900 ft.
Sheephorn Divide, North Park.
Sherwood, Eagle Co.; alt. 6,900 ft.
Sherwood's Ranch, (Glen Eyre) Larimer Co., on the Laramie; alt. about 7,800 ft.
Sierra Blanca, Sangre de Cristo Range, Costilla and Huerfano counties; alt. 14,483 ft.
Sierra Madre Range, name given by Fremont to Main Range from Georgetown south.
Sierra Sangre de Cristo, or Sangre de Cristo Range, separates the San Luis from the Huerfano and Arkansas watersheds, Saguache Co. Many high peaks, the highest 14,483 ft.
Silver Plume, Clear Creek Co.; alt. 9,188 ft.
Silverton, San Juan Co.; alt. 9,201 ft.
Slide Rock Cañon, west of La Plata mountains, north of Mt. Hesperus, alt. 10,000 to 12,000 ft.
Smith's Fork, Delta Co., tributary of the Gunnison; alt. 7,000 ft.
Soda Creek, Routt Co., a tributary of Bear river.
Soldier Cañon, west of Fort Collins; alt. 5,000 ft.
South Boulder Cañon, near Boulder; alt. 5,600 ft. upward.
South Cheyenne Cañon, foot of Cheyenne Mountain, southeast of Pike's Peak; alt. 6,000 to 10,000 ft.
South Cottonwood Gulch, Chaffee Co., near Buena Vista; alt. about 10,500 ft.
South Park, between the Park Range and the Front and Rampart ranges, drained by South Platte river.
South Table Mountain, southeast of Golden; alt. 6,250 ft.
Spanish Peaks, Huerfano Co., two isolated peaks near Culebra Range; alt. west Spanish Peak, 13,620; east Spanish Peak alt., 12,720 ft.
Spicer, Larimer Co., on Grizzly Creek; alt. about 9,000 ft.
Sprague's, Moraine P. O., Estes Park; alt. about 8,000 ft.
Squaw Hill, Montrose Co.; above Cimarron; alt. 7,000 to 8,500 ft.
State Bridge, Costilla Co., east of Antonito, Rio Grand; alt. 7,348 ft.
State Bridge, Grand River, east of Delta; alt. about 5,000 ft.
Steamboat Springs, Routt Co.; alt. 6,500 ft.
Steele Cañon, near Villa Grove.
Stephen's Mine, near Gray's Peak, at timberline; alt. 11,500 ft.
Sterling, Logan Co.; alt. 3,922 ft.
Stove Prairie, Larimer Co., beyond Rist Cañon; alt. 7,600 ft.
Stove Prairie Hill, head of Rist Cañon; alt. about 8,000 ft.
St. Vrain Cañon, Cañon of St. Vrain Creek, Boulder Co.; a tributary of the South Platte River.
Sugar Loaf Mountain, Eagle and Summit counties; alt. 12,556 ft.
Sulphur Springs, Grand Co.; many in various parts of the state.
Sunset Cañon, near Sunset, Boulder Co.; alt. at Sunset, 7,707 ft.
Sunshine, Boulder Co.; alt. 12,945 ft.
Swallows, on Arkansas River, between Pueblo and Cañon City; alt. 4,863 ft.
Sydney, or *Sidney*, Routt Co., on Bear River.
Table Rock, east of Palmer Lake; alt. 7,150 ft.
Taylor River, Gunnison Co.; alt. 8,000 to 11,000 ft.
Teller, an abandoned mining camp, south of North Park; alt. about 9,000 ft.
Telluride, San Miguel Co.; alt. 8,756 ft.

- Tennessee Pass*, near Leadville, between the watersheds of the Arkansas and Eagle rivers; alt. 10,240 ft.
- Thompson's Cañon*, Long's Peak, drained by Thompson Creek; alt. 5,500 to 6,000 ft.
- Thompson's Park*, west of Dix, La Plata Co.; alt. 7,576 ft.
- Tie Siding*, upper waters of Fish Creek, Wyoming, near Larimer Co. line; alt. 7,800 ft.
- Timnath*, Eastern Larimer Co.; alt. 4,875 ft.
- Tobe Miller's Ranch*, near La Porte, Larimer Co.; alt. about 5,300 ft.
- Tomichi River*, tributary to Gunnison River; alt. 7,600 to about 11,000 ft.
- Trail Creek*, Larimer Co., a tributary of North Poudre; alt. 6,500 to 7,500 ft.
- Trail Creek*, on Pike's Peak, El Paso Co.
- Trail Glen*, Pike's Peak; alt. about 9,000 ft.
- Trapper's Lake*, Garfield Co.; alt. 11,000 ft.
- Trimble Hot Springs*, La Plata Co., near Durango; alt. 7,000 ft.
- Trinidad*, Las Animas Co.; alt. 5,994 ft.
- Troublesome*, Grand Co., near Troublesome Creek; alt. about 7,300 ft.
- Troublesome Creek*, Grand Co., a tributary of the Grand River; alt. 7,300 ft. to 11,500 ft.
- Turkey Creek*, a tributary of Huerfano River.
- Turkey Creek*, also a tributary of Arkansas River west of Pueblo, south of Mt. Rosa; alt. 5,000 to 11,000 ft.
- Twelve Mile Creek*, Park Co., east of Weston Peak.
- Twin Lakes*, Lake Co.; alt. 9,367 ft.
- Uncompahgre Mountains*, between Gunnison and Hinsdale counties.
- Uncompahgre Peak*, Uncompahgre Mountains; alt. 14,419 ft.
- Uncompahgre River*, a tributary of the Gunnison River; alt. 4,000 to 7,000 ft.
- Ute Creek*, Hinsdale Co., a tributary of the Rio Grande.
- Ute Creek*, Costilla Co., a tributary of Trinchera River.
- Ute Pass*, west from Manitou, followed by Colorado Midland P. R.; alt. 9,100 ft.
- Valley Spur*, east of Pitkin, Gunnison Co., station on the C. & S. R. R.
- Valmont*, Boulder Co.; alt. 5,200 feet.
- Valverde*, Arapahoe Co., Denver suburb; alt. 5,212 ft.
- Van Boxle's Ranch*, above Cimarron; alt. 4,000 to 8,000 ft.
- Vance Junction*, San Miguel Co., near Telluride; alt. 8,101 ft.
- Veta*, see La Veta.
- Veta Mountains*, Huerfano Co.; alt. 11,176 ft.
- Veta Pass*, between Cucharas and Trincheras watershed, Culebra Range; alt. 9,242 ft.
- Victoria*, Larimer Co.; alt. 8,000 to 9,000 ft.
- Villa Grove*, Saguache Co.; alt. 7,972 ft.
- Wagon Wheel Gap*, Mineral Co., on the Rio Grande; alt. 8,449 ft.
- Wahatoya Cañon*, between the two Spanish Peaks, Huerfano Co.; alt. 6,489 ft.
- Walden*, North Park, Larimer Co., on Coal Creek; alt. 8,050 ft.
- Walsenburg*, Huerfano Co.; alt. 6,187 ft.
- Walton Creek*, Eastern Routt Co.; alt. 6,800 ft.
- Ward*, Boulder Co., on "Switzerland Trail;" alt. 9,217 ft.
- Webster*, Park Co., on C. & S. R. R.; alt. 8,979.
- West Cliff*, or *Westcliffe*, Custer Co.; alt. 7,861 ft.
- West Indian Creek*, Costilla Co.
- West Mancos Cañon*, cañon of the Rio Mancos, Montezuma Co.
- Weston Pass*, south southeast of Leadville; alt. 11,930 ft.
- West Spanish Peak*, see Spanish Peaks.
- Westwater*, Utah line, just west of Grand Junction.
- Whitehouse Mountain*, west of Ouray; alt. 13,496 ft.
- White River Plateau*, divide between White and Grand rivers; alt. 11,000.
- William's Cañon*, near Manitou; alt. about 7,500 ft.
- Willis Gulch*, Gilpin Co., near Central City; alt. about 8,800 ft.
- Willow Creek*, Routt Co.
- Willow Creek*, Teller Co., southwest of Cripple Creek.

Windy Point, Pike's Peak Cog Road; alt. 12,300 ft.

Wolcott, Eagle Co.; alt. 7,000 ft.

Wood's Ranch, on Trail Creek, Larimer Co.; alt. about 7,500 ft.

Wray, Yuma Co.; alt. 3,512 ft.

Yampa, Routt Co.; alt. about 7,000 ft.

Yuma, Yuma Co.; alt. 4,138 ft.

Zada, or *Zola*, Routt Co., near Pass Butte (?)

Zimmerman's, see Home P. O.

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The English names are given in common small letters, the Latin generic names in *italic*, and the names of Tribes, Families, Orders, and the higher divisions, in small capitals.

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ERRATA.

- Page 2, line 15, *Northolaena* read *Notholaena*.
Page 55, *Ageliops*, read *Aegilops*.
Page 120, lines 5, 7, 10, 13, "*Swaeda*," read "*Suaeda*."
Page 131, line 18 "*Callian*," read "*Calhan*."
Page 150, lines 19 and 20 go out, and the numbers for *Roripa*, *Turritis*, *Schoenocrambe* and *Sisymbrium* become 9, 10, 11, and 12 respectively.
Page 155-167, the numbers of *Roripa* and the following genera of BRASSICACEAE should be changed to agree with the numbers in the key.
Page 171, *Pectianthia*, read *Pectiantia*.
Page 189, line 21, "Mountain Holly," read "Mountain Mahogany."
Page 190, The numbers in the key to *Rosa* should be changed to agree with those in the list following.
Page 192, The first five localities under *Amelanchier alnifolia* belong to *A. oreophila* instead.
Page 201, *Trifolium pratensis* read *Trifolium pratense*.
Page 202, line 30 "Bird's-foot Treefoil" read Bird's-foot Trefoil.
Page 208, Numbers in the key of *Kentrophyta* should be changed to correspond with those of the following list.
Page 216, The number of *Vicia* should be 35 instead of 33 and on
Page 217, that of *Lathyrus* 36 instead of 34.



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OF THE

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The Western Cricket.

LIFE HISTORY AND REMEDIES

— BY —

C. P. GILLETTE.

MIGRATORY HABITS

— BY —

S. ARTHUR JOHNSON.

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THE WESTERN CRICKET.

(*Anabrus simplex* Hald.)

LIFE HISTORY AND REMEDIES.

BY C. P. GILLETTE.

This so-called cricket, which is really a grasshopper with very short wings, attracted attention as an injurious insect in Colorado for the first time last year. The insect is not in any sense new, for it was here long before any white man set foot upon American soil. This grasshopper and its habit of marching in great armies have been written about for more than 50 years.* Judging from many published reports, this insect occurs in greatest numbers over the sage brush plains and hills drained by the Snake river and by Great Salt Lake, in Southern Idaho, and Northern Nevada and Utah. The occurrence of large swarms of the "crickets" in Southwestern Wyoming or Northwestern Colorado is not common, to say the least. Where it was most numerous in Routt county the past summer in the vicinity of Eddy, Dunkley and Hayden, the ranchmen declared that the visitation of the past two or three years in that region is the first in the memory of the oldest inhabitants. Such an unusual invasion is not likely to continue through many years.

When the seriousness of the Routt county invasion became known to this office, Mr. S. A. Johnson started on an overland trip through the infested area to learn as much as possible of the migrating habits and the past history of this insect, and the writer went directly to Steamboat Springs, Eddy and Dunkley to study the habits and possible remedies where some of the worst injuries were being inflicted. I was fortunate in falling into the hands of Mr. John A. Whetstone and Mr. W. W. Miles of Eddy, who showed me

* Some of the more important publications upon this insect are Stansb. Explorations of Utah, 1852, p. 372; Glover, Rep. U. S. Dep. Agr., 1871, p. 79; Thomas, Ann. Rep. U. S. Geol. Survey of Terr., Vol. V, p. 438; Bruner, Rep. U. S. Entomological Com., Vol. II, p. 163, and Vol. III, p. 61, and Bull. 27, U. S. Dep. of Agr., Div. of Entomology, p. 31; Doten, Bull. 56, Nevada Exp. Sta., Reno (This bulletin would be of special interest to ranchmen); Aldrich, Bull. 41, Idaho Exp. Sta., Moscow; Gillette, Entomological News, Vol. XV, p. 321 (giving breeding and egg-laying habits).

every courtesy and gave valuable assistance in carrying on my investigations.

I reached Steamboat Springs, July 24th, where I found nearly everyone had heard of the swarms of black crickets that had overrun the town of Hayden, and had invaded various ranches between that place and Eddy, and were wanting to know if there was any danger of their reaching Steamboat Springs in their eastward march. I left for Eddy on the morning stage of the 25th of July, but was soon met by Mr. John A. Whetstone, who took me to his home near Eddy, where there was a rather large swarm of the crickets camping upon a large "hog back" just west of his ranch. The crickets had been down to an irrigating ditch along the west side of the ranch, but had not crossed in sufficient numbers to do any harm, though there was no telling how soon they might do so. Mr. W. W. Miles, postmaster at Eddy, was also afraid that the crickets might destroy his crops, and they did do considerable injury to a field of oats and a field of rye belonging to him. This swarm had ceased its regular migrations, and for some two weeks Mr. Miles said the hoppers had been wandering about, going down the hills to a ditch or stream of water and then returning to the hill tops. The swarm was one of medium, or rather large size, and, as near as I could estimate, when all moving in one direction, they covered an area about 300 yards across by half of a mile in length. This seemed a favorable location, so I stayed a few days to make observations and try a few experiments.

APPEARANCE OF THE CRICKETS.

At the time of my arrival at Eddy, the crickets were all quite dark in color; a casual observer would call them black. I was told they were more reddish in color, earlier, and probably this is specially true just after molting (shedding their skin). The real color was a dark brown, tinged with olive green and more or less mottled, especially upon the abdomen and legs, with yellowish brown. Specimens from Nevada, sent me by Professor Doten, were distinctly more rufous in color. Both males and females measure from about 1 1-3 to 1 1-2 inches in length. The females are easily distinguished by the long "tails," or ovipositors, measuring about $\frac{7}{8}$ of an inch in length and nearly straight, but slightly curved. See Plate I, Fig. A, which shows the female life size. In place of the ovipositor, the males have a pair of double hooks, or clasping organs, with which they hold to the female during copulation. These are shown at E in the same plate. The wings are very small, the front pair being largest, and are used by the males for the purpose of making the chirping or squeaking noise that is always heard when one disturbs or frightens them. The noise is made by rubbing one wing over the other. Ordinarily the wings

are entirely hidden by the large cape, or pronotum, back of the head, but this can be raised, exposing the wings to view. The anterior pair of wings of the male are shown twice natural size at Plate I, Fig. F.

OBSERVATIONS ON HABITS.

Breeding Habits. From about 8 o'clock in the morning until noon or a little after, I noticed many of the females carried about with them, at the end of the abdomen, a large mass of white, jelly-like material (See Plate I, Figs. C and D). Suspecting that this phenomenon was connected in some way with the breeding habits of the crickets, I made observations which resulted in learning that this white, blubber-like mass is received entirely from the male while in copula. So, whenever these white bodies are observed, one may know that the egg-laying season is already on or about to begin. Mr. W. W. Miles told me that he saw a great many of the females with these masses attached to them on his ranch on June 27. This would indicate that egg-laying begins about the first of July, which agrees well with observations by Mr. John L. Yoast, who told me that egg-laying began in 1903 about July 1st, and lasted till the 10th of September, at least.

The crickets were laying eggs freely during all the time of my visit. Dr. W. P. Headden was in Routt county in August, and reported the females depositing eggs freely on the hills between Trout Creek and Grass Creek, two miles northwest of Dunkley, August 17.

The Eggs, when ready to be deposited, are dark chocolate brown in color, but when the surface has dried off, the color is a uniform light gray. The eggs are about one-quarter of an inch in length by one-sixteenth of an inch long, and are nearly straight. They are not deposited in compact clusters, but are distributed loosely to the depth of about an inch, those at the surface often protruding a little. They are shown, natural size, at Plate I, Fig. G.

The eggs are deposited anywhere that the female is able to insert her ovipositor as the crickets are wandering about after the active migrating season is over, but they prefer hill tops or hill sides, and soil that is not very hard. On the hills near Eddy, where the swarm under observation was staying, I saw, on different days, one favorite area of several acres where the females were busy egg-laying. The ground was literally blackened with them, but at my approach, they would draw out their ovipositors, which are inserted almost vertically, and go hopping away. Two samples of surface soil were taken at random from the top of this hill and the eggs counted. In one instance there were over 2,000, and in the other over 3,000 eggs to the square foot of surface. If the eggs should all hatch, there would barely be standing room for the young hoppers, and the egg-laying season was only nicely begun.

How many eggs a female may lay was not accurately determined, but in one female I counted 133 eggs in different stages of development. The eggs are not all deposited at one time, neither do the eggs seem to develop in sets or broods, for in a single female would be found ova that were very small, and all gradations between these and those that were fully grown and ready to be deposited. On July 27, I counted the eggs in the ovaries of a number of females that were carrying about the sperm masses and found the immature eggs to range between the numbers 34 and 46, and the mature eggs to range between 10 and 35.

The Chirping, or squeaking, which is done entirely by the males, has two objects—to attract the females, and to serve as a note of warning. Early in the morning one standing quietly among the crickets, will hear the constant chirping of the males, but in the middle of the day or in the evening all will be quite, as a rule, until a step is taken or a motion is made, when the chirping will suddenly begin, and all the crickets within a radius of 20 feet or more will begin hopping or running away as if frightened. When traveling without being frightened, they always walk. When night comes on they climb into the bushes in great numbers and remain until morning. They are very shy, however, and will drop from the bushes and weeds on the approach of a moving object.

Their food is quite varied, but they have their preferences. They were seen eating the leaves of sage brush (*Artemisia tridentata*), but they seemed to prefer more succulent food, either weeds or cultivated plants. Oats, rye, wheat, alfalfa, potatoes and most garden vegetables were eaten greedily by them, but I was told that peas and timothy were hardly eaten at all. They are very cannibalistic; in fact, they seem to prefer a struggling, dying companion to anything else that can be given them as food. Mr. Miles told me that he killed a rattlesnake near a swarm of the crickets and a day after, he was passing the place and noticed the cleaned skeleton of the snake, which the crickets had completely stripped of all its flesh. After dining upon mountain trout with Mr. and Mrs. Miles and family, I asked Mrs. Miles if I might have the bones, many of which carried considerable meat, to feed to the crickets. She gave her consent, and the hoppers ate of the fish with apparent relish. They are also very fond of fresh horse manure and often eat cattle dung. Mr. J. H. Yoast said they ate greedily of corn meal which he gave them. An insect with such food habits is not likely to die very soon of starvation.

THE YOUNG CRICKETS.

On December 4, Mr. J. H. Yoast of Dunkley, collected and sent me a large quantity of the eggs of the cricket, and on the day following, Mr. W. W. Miles of Eddy, collected and sent a lot. As

soon as received, a number of the eggs were opened and the little crickets were fully formed and ready to emerge. On Dec. 12, the young crickets began hatching and seemed perfectly normal and active for a time, but artificial conditions did not agree with them and all died after living a few days.

A letter from Mr. J. H. Yoast, dated March 13, 1905, stated that the young crickets had already hatched in millions on the hill-tops on the south side, where the snow was off.

DESCRIPTION OF YOUNG CRICKETS.

When first hatched, the crickets are a light flesh color throughout, except the black eyes, but soon become quite black with a broad, flesh-colored stripe the entire length of the back. Along the middle of this light dorsal stripe are two black lines separated by a narrow line of the flesh color. The hind margin of the cape, or pronotum, immediately above the front pair of legs, is very conspicuously light yellow, almost white. Antennæ somewhat longer than the body and black.

MEANS OF CONTROL.

NATURAL ENEMIES.

The greatly increased numbers of this grasshopper are probably due to continuous favorable conditions for their development, especially proper climatic conditions during the winter and spring months, and to a decreased number of natural enemies, such as insect parasites, birds and certain mammals. We have bred no parasites from the crickets and have found none in their bodies upon dissection. Bears and coyotes feed upon them, but birds destroy them in greatest numbers. The birds I most noticed were hawks, sage grouse, and blackbirds. The blackbirds were specially destructive, as they would gather in large flocks, and they did not devour the crickets entire, but would eat only a small part of a single cricket, as a rule. Ptarmigan and gulls have also been reported as feeding freely upon the crickets, and Mr. John H. Yoast wrote me last winter that the horned larks were very active about Dunkley devouring the eggs.

ARTIFICIAL REMEDIES.

This is a difficult insect to cope with successfully and yet the writer is satisfied that much can be done to prevent its depredations to cultivated crops. The remedial measures may be divided into two classes—preventive, and destructive.

PREVENTIVE MEASURES.

Herding. One of the simplest and most common of these is

"herding" or driving. This consists in going in front of the swarm and conducting a flanking movement to turn the line of march to the right or left. I am told by the ranchmen that it is useless to try to turn the swarm back, but it may be deflected to one side. This is done in various ways: sometimes men, women and children go ahead of the swarm with bushes that they use by beating the ground as they travel back and forth; often saddle ponies are ridden back and forth, and sometimes bells are jingled, and tin cans are beaten with sticks or stones. From some tests that I made, it seemed to me that the hoppers cared little or nothing for noises, but they are frightened by an object in motion. Ropes and chains are also used to drag behind horses or between men walking or riding.

Ditching with vertical banks next to the field which is to be protected, and with frequent deep holes like post-holes in the bottom into which crickets will fall and pile up, have been used with some success, but it is doubtful if there are many cases where it would be practical to turn aside or destroy the crickets in this manner, unless a rapid flowing stream of water can be kept running in the ditch, in which case the holes in the bottom of the ditch would not be necessary.

Fencing. The crickets have the reputation of being able to climb a window pane or any other vertical surface, no matter how smooth. This was not true of the adult crickets that I made observations upon at Eddy. I was unable to get one to climb up a vertical surfaced board until it was inclined to a considerable angle, and they were utterly unable to cling at all to verticle tin, glass, corrugated iron roofing, oilcloth, or ordinary glazed wrapping paper, such as is used everywhere in meat markets and in other stores to wrap goods in.

Professor Aldrich, in Bulletin 41 of the Idaho Experiment Station, reports the use of boards eight inches wide, placed edge-wise, end to end, about a garden, with a strip of tin on the upper edge projecting horizontally two inches as a barrier, that the crickets can not crawl over. Professor Doten of the Nevada Experiment Station, printed a letter from Prof. Kellogg of Stanford University, which says that in Washington state six-inch boards are used effectually in the same manner, except that the tin strip is about five inches wide and is placed vertically and recurved outwardly. I tried the fence as described by Prof. Aldrich, and found it quite satisfactory. Care must be taken to have the tin projecting fully two inches. It seems to me that the ideal way would be to have this fence along the border of a ditch on the side next the crop, so that the crickets would fall back in the water and be carried down stream. Surfaced boards would be best, but if only rough boards were at hand, these could be covered with oilcloth or glazed paper.

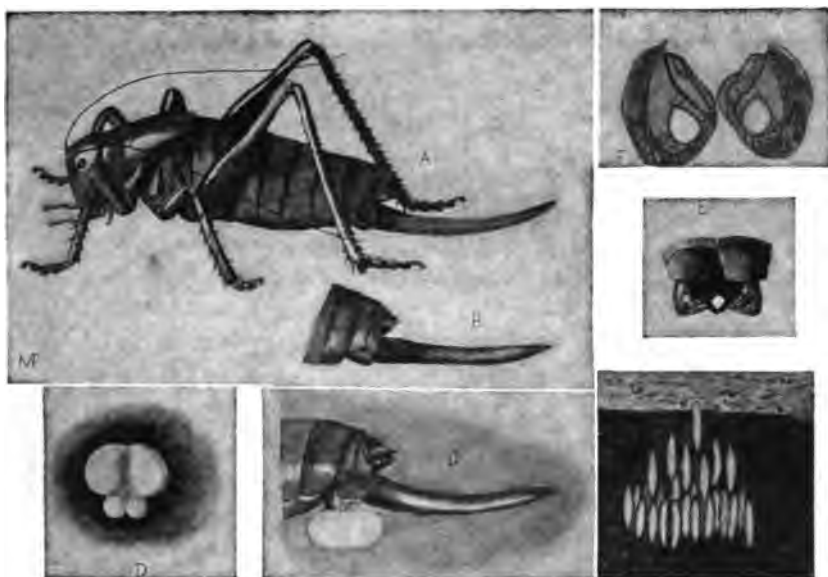


Plate I. ANABRUS SIMPLEX.

A, adult female; B, a comparatively straight ovipositor; C, blubber-like mass clasped by the vulva of the female; D, the mass removed immediately after copulation, showing the two small lobes that are clasped by vulva of female; E, end of male abdomen from above, showing clasping organs; F, wings of adult male; G, a cluster of eggs in the ground, the upper one protruding above the surface. All natural size, except E and F, which are twice natural size. Miss Miriam A. Palmer, artist. Original in *Entomological News*, December, 1904.

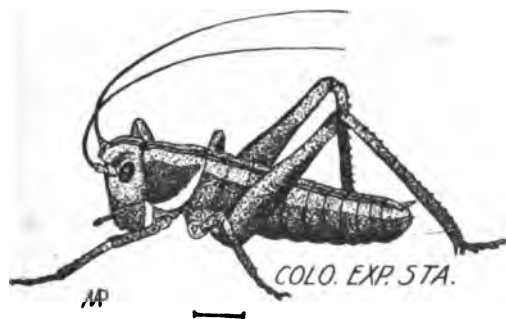


Figure I.

FIGURE I. Young of the Western Cricket (*Anabrus simplex*) only a few hours from the egg; enlarged six times. Miss Miriam Palmer, artist.

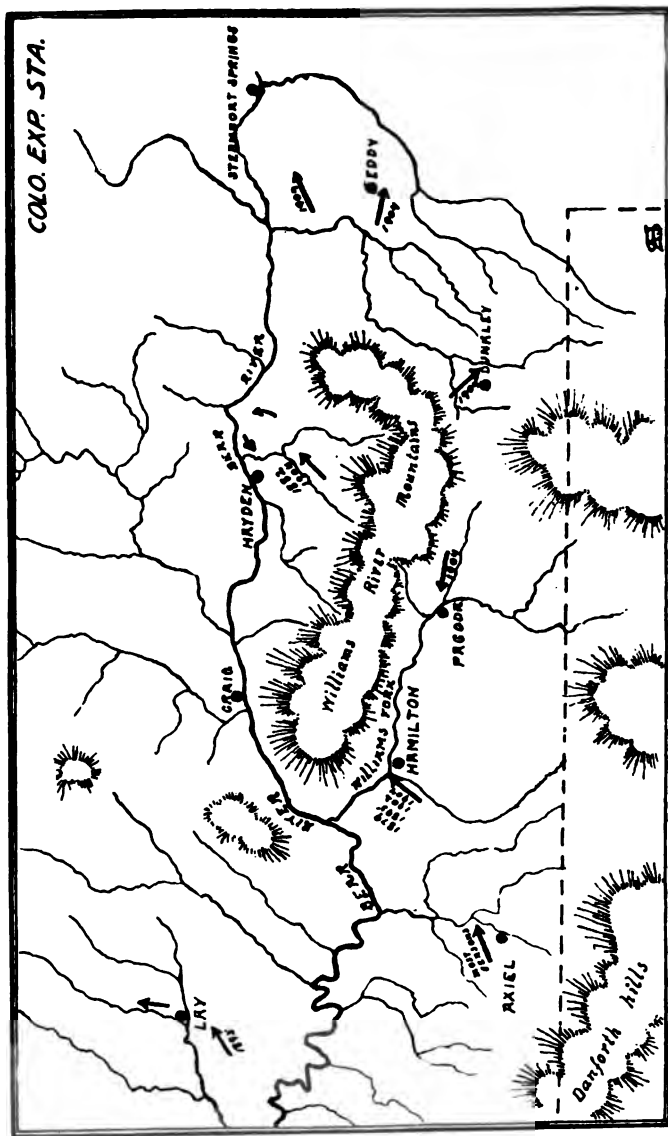


Plate II. MIGRATIONS AND DISTRIBUTION OF THE WESTERN CRICKET IN ROUTT COUNTY, COLORADO.

The arrowheads show the direction in which the migrations took place. The dates near them record the years that they passed the given locations.

Where it is obtainable, long, narrow strips of corrugated or other sheet iron could be used alone.

DESTRUCTIVE MEASURES.

While I was only able to make a few tests in a small way of any means of destroying the crickets, it seems to me that it is here that we shall find some of the most promising methods of keeping these destructive insects in check. First, and perhaps most promising among these methods, I will mention the use of

Coal Oil or Petroleum on Water. I find some who have used coal oil on water, report good success and others report failure. One party who used the oil at Hayden last year said, "We killed them all right when we used enough oil." I am confident that wherever a vertical ditch bank or a fence upon one of the above plans can be used to tumble the crickets back into the water of a ditch that they are crossing, that they can be killed in enormous quantities with the oil, as follows:

Throw a dam across the ditch, arranged so as to allow the water to escape through an opening near the bottom of the dam, but not allowing it to run over the top. The water will back up and can be covered with a heavy film of oil that will not run off, and, as the crickets accumulate above the dam they could be raked out and shoveled into a pile. They would make an excellent fertilizer.

Poisoning. I tested white arsenic, dissolved, and as a powder, and Paris green for the destruction of the crickets. I found that it was necessary to use the poisons freely in order to kill at all quickly. I found that the dissolved arsenic was most satisfactory in its results. I also found that the crickets are very fond of sugar and took the poisons more freely when sweetened. The poisons were put upon green vegetation, such as cabbage leaves and beet leaves, and upon fresh horse manure. It seems probable that poisoned baits of green food placed in the track of the crickets, especially in the early morning, might be quite effectual in destroying them. I would use the poison in the proportion of about 1 pound to 10 gallons of water, and thoroughly moisten the food with it. Enough sugar to sweeten the bait a little will make it more acceptable. Poisoned sweetened water put anywhere in the way of the crickets might serve to kill them.

Where the crickets are marching into a field of oats, potatoes or other cultivated crop, I believe an arsenical poison in the proportions mentioned above, sprayed upon the plants along the border of the field where the crickets first enter, would destroy a large proportion of them. The first that die will be eaten by their comrades, and so one dose may do double duty. It might be practical to poison the native food-plants where the young feed before taking on their marching habit.

If it is desired to dissolve the arsenic, this may be done by boiling a pound of it in a gallon of water with two pounds of soda. This may then be diluted to 10 gallons. If living plants are to be sprayed, it will probably be better to use the arsenic or the Paris green without dissolving; simply mix them with the water.

Plowing. Some times the eggs are deposited in great numbers where they may be turned deeply under by plowing. This would probably prevent the escape of the little crickets when they hatch.

Burning. Whenever there is enough dry vegetation to burn on the hills where most of the eggs are laid, fire could be used to advantage.

Crushing. When a swarm is on level ground, great numbers can be killed by running a roller over them.

Great numbers can often be killed by driving sheep about over the swarm.

In mentioning remedies, I have been unable to speak from any practical experience, having had none. I have done what I could to collect information from the experiences and reports of others and have made some observations and tests in the field in the vicinity of Eddy and Dunkley, and offer the above remedies as suggestions. I would like to speak more definitely, positively and encouragingly of some remedy, but can not as yet. If the crickets should continue to increase the present year, I hope, with the co-operation of the ranchmen, to carry on some tests of remedies in a more practical and extensive way in the field the coming summer. I shall be glad to be kept fully informed of the conditions and movements of the crickets during the present season. If anyone should test any of the remedies suggested, or others, I should be very glad to be notified of the results, whether successful or not. Valuable information gained by the Experiment Station will be given out to the ranchmen, and in these ways we may be mutually helpful.

DISTRIBUTION AND MIGRATIONS.*

BY S. ARTHUR JOHNSON.

An extended trip, occupying nearly two weeks, was taken in the summer of 1904 through that part of Routt county which is subject to invasion by the western cricket. Special attention was given to securing data and observations on the migrations and habits of these insects.

This species was studied to some extent during the seventies and early eighties by the Entomological Commission of the U. S. Government.* *

The observations made at that time confirm the conclusions arrived at last summer, that the cricket has its permanent home in certain dry hills. They live and prosper there every year, but success comes to them as it does to other insects, in liberal proportions on certain years. The young have a curious and unexplained habit of migrating. These events appear to have only slight connection with the abundance of food, though the most numerous bands travel the greatest distances. On reaching a desirable pasture they first eat ravenously and then resume the march. The latter part of the army crowding upon the leaders causes them to move forward. If the band is very large, the crowding will give rise to a more rapid pace than where the numbers are smaller.

The migrations appear to have a marked relation to the distribution of the species. The successful breeding grounds are dry hills, which are often at considerable distances from each other. Since the insects are unable to fly, it would be next to impossible for isolated individuals to reach new territory. This can be, and is, accomplished by the armies, which even pass considerable streams in their march.

The homes, so far as we can learn, appear to be of two kinds: permanent, where the insects are always more or less abundant; and temporary, where the migrating hordes reach a new locality

* A more detailed account of this phase was presented to the Association of Economic Entomologists at their last meeting and will appear with the proceedings of that body.

* * Second Report of the U. S. Entomological Commission, pp. 163-170. Third Report of the Entomological Commission, pp. 61-64.

which is favorable to the laying of eggs. In the latter case the new grounds furnish a resting place, where the insects may be found for a greater or less length of time. If they are successful here, they may invade new territory, or, on the other hand, they may be overcome by enemies and adverse circumstances and disappear.

A trait of this species, as well as some others of the same genus, is to travel in bands of greater or less magnitude. When the eggs hatch well, these bands assume almost incredible proportions. Prof. Bruner states: "As a rule, they collect into lines varying from a few to hundreds of yards in width, and from a few hundred feet to a mile or more in length." These armies migrate in different directions from the breeding grounds, as if by common consent. The sight of an army on the march is one of the most wonderful in the insect world. The heads are all in one direction; the troops move along in a steady and orderly fashion without confusion or much noise, the members traveling on "all sixes." The sight of a band in its progress reminds one of the movement of a full stream. There is the same steady motion and ceaseless flow. So far as we observed, it was only when alarmed that the insects began to jump, and the sharp, warning notes of the males set the surrounding members in commotion and precipitous flight. Most observers state that the line of direction is not changed; that the insects will cross streams and ditches, climb cliffs and go over houses and fences, rather than change their purpose. This can be true only in part. It is well known that many separate armies have followed rather tortuous courses during their periods of wandering. They are commonly diverted from entering cultivated fields by herding. Many original armies appear to have been split into different bands and thereafter to have pursued widely diverging lines. All of the things mentioned above are true, but their persistence in a distinct direction in any particular case is probably due to the pressure of their companions on all sides, which makes a change impossible.

We lack definite data regarding the exact period in the insect's life when the migrations begin, but observers say that when they are first herded they are of all sizes, and some report that at the first appearance the insects are very small.

The length of time employed in travel depends largely upon the time of maturing of the insect. During the summer of 1904, the forward march was not continued beyond the middle of July. The visitation, however, was said to be earlier than usual, owing to the nature of the spring, which caused the eggs to hatch at an early date.

When the egg-laying period is reached, the insects retire to the dry hills, where they spend their time providing for their off-

spring. The migrations after this period begins consist only in short trips from the breeding grounds to feeding places and back. When in the neighborhood of water they have been observed to go to it, drink and retire. The gregarious habit still prevails. The bands, though somewhat scattered, still maintain their entity. Usually the lines marking the margins of a group are sharply defined and only a few stragglers are to be found beyond its limits.

The distances to which the insects may travel during the migrations and the rate of travel vary greatly. The bands which reached Eddy and came within five miles of Steamboat Springs may have traveled between fifteen and thirty miles. It is not altogether certain where the starting point was. The band which reached Lay, traveled much farther. With regard to the rate of travel we have one authentic record. The army which found its resting place at Pagoda was reported by telephone from four miles up the fork a week before it reached that place. That is, it traveled at the rate of something over half a mile per day.

The traveling, so far as we observed, was done entirely by daylight. At night the insects mass themselves upon the sage brush or other vegetation and remain there until daylight. The Entomological Commission records that the invasions were made at night, but such was not our observation. Reports were made, however, of insects being found in the houses in large numbers early in the morning.

Several localities were found where the insects were ovipositing. They were invariably dry knolls, which were nearly or quite barren of vegetation, and where the soil was soft and usually clayey. The eggs did not appear to be numerous in any locality west of Dunkley. At Pagoda four counts were made of separate deposits which contained 18, 4, 9 and 14 eggs, respectively.

There is but little doubt that the western cricket is permanently located in the Danforth hills (See map) south and west of Axiel. A lady living there reported that on her ranch seven miles east, it was necessary to fight the insects almost every year. They come in from the west and travel east and up canons, and are kept off the crops by herding and noise. The insects are sometimes quite young when they appear, and the invasions are liable to continue until they are full grown and retire to the hills.

At Hamilton, a town perhaps twenty miles east of Axiel on the William's Fork of Bear river, we were able to obtain definite data regarding them.

The first observations were made by Mr. T. H. Hamilton in 1879. He kindly gave me the following notes: From here the insects travel northeast, and to accomplish this it is necessary for them to cross William's Fork, which flows quite rapidly at this point. In making the attempt, immense numbers were drowned

and floated down the river, but the rest succeeded in crossing. A glance at the map will show that they found themselves immediately in the William's River mountains. Here they located and laid eggs which hatched the following spring as soon as the snow began to melt. The young endured the rigors of the season without apparent inconvenience. Frequently at night they would freeze, only to thaw out the next day and renew operations. Sometimes they were buried beneath the snow, where they remained until that was melted.

Three years later (1882), a horde visited Hayden, a town north and east of Hamilton on the opposite side of the William's River mountains. During this visitation they did considerable damage to gardens and crops, which at that time, however, were not so important a feature as they have since become. It seems probable that the drove which visited Hayden were the descendants of those at Hamilton three years before. The first brood may have found a temporary home in the William's River mountains, in which they gathered sufficient strength to make the invasion into Hayden.

We have two records of the next great migration, which occurred in 1895. They were made at Hamilton and at Lay. The first was observed by Mr. Hamilton, and the second by Mrs. Callahan. Lay is located thirty miles west of Hayden and seven miles north of Bear river. The drove, which was not very large at this place, came from the southwest and went north. The remarkable feature is that the insects must have come across Bear river, since there are no hills between this and the river where they are located. The original brood must have been enormous, for even the large numbers at Hayden this year failed to effect a crossing. The band was evidently following up the valley of Juniper creek. It is not an uncommon habit for the insects to follow a river valley when migrating. The general direction of the broods must have been more northerly than usual, for this is the only record we have of a visit to this locality.

The third great migration reached Hamilton in 1900 and a second wave followed in 1902. Both crossed the William's Fork as the previous broods had done. During the last trip they destroyed twenty-five acres of grain belonging to Mr. Hamilton, who herded them off the garden with partial success. Attempts were made to poison the insects with Paris green and to kill them with kerosene oil, but owing to the immense numbers these methods were of little avail.

Eggs were laid again in the Hayden divide and apparently, at least, gave rise to the unprecedented numbers of 1904. It is not quite certain how long the insects have been located on the Hayden divide. Some say that they have been there for the past ten

years, which would throw their existence back to the brood of 1895. Observations by ranchmen are intermittent and occasional. The country is extensive and seldom visited by the people in every locality. Owing to the gregarious habits of the pest, it is quite possible that small bands could exist in the hills for years without being observed. In any case, the migrations of 1900 and 1902 must have been an important factor in overpopulating the breeding grounds.

The spring of 1904 opened very early, and in the first part of summer the hordes began to come down among the ranches from the Hayden divide. Judging from the directions in which the broods traveled, eggs must have been deposited the previous year over a large proportion of the range.

At Hayden the insects appeared about the first of June, traveling east and northeast. On reaching the ditch between the hills and cultivated fields, they leaped into it and crossed. Many dead and living floated down the ditch, where they lodged against a dam, making a mass forty feet long, one foot deep and perhaps four feet wide.

The chief injuries were to potatoes, alfalfa and young clover. No remedies were effective. Coal oil was permitted to drip from the bottom of a can into the ditch. This, floating over the surface of the water, did good service, but the price of coal oil in this locality is so high that the remedy is an expensive one.

The army traveled on until it came into contact with a bend in the Bear river, when it was deflected from its course, and, following the current of water, visited Hayden a second time a few weeks later. At the time of our visit, during the latter part of July, the adults were to be found in considerable numbers in the hills south of Hayden, where they were ovipositing. Search was made for eggs, but they did not appear to be abundant.

Swarms, coming apparently from the eastern end of the divide, invaded the country toward Eddy and Steamboat Springs. There seems to have been several divisions of this migration. At Dunkley, Mr. Yoast herded them off his crops for weeks, after which they seemed to retire to the Hayden divide, which is contiguous to this place. An immense swarm reached Eddy and located in the hills at that place, where eggs were laid in greater abundance than was noted at any other locality.

Still another band, taking a northeasterly direction, made its way to within a few miles of Steamboat Springs.

A very large band entered the valley of the William's Fork and followed it, traveling west to Pagoda, at which place it was within twelve miles of the spot where the original migrants crossed the fork at Hamilton. The numbers were so great that they were piled in the road several inches deep. Numbers died in the ditches,

but others entered the alfalfa fields, which they destroyed for a distance of thirty or forty feet, eating the leaves and tender shoots, but leaving the bare stems standing. Garden crops suffered severely and a field of oats was eaten almost to the ground. They were herded off the crops with bells and riding horsemen, but this was only partially successful. The insects persisted in their attacks for two weeks, after which they retired to the hills.

As already stated, the Entomological Commission studied this insect in the latter seventies. Prof. Packard records its injuries from 1865 to 1879 in Utah, Idaho and Nevada, and states that the insects were becoming less destructive than formerly. From that time until recently but little attention has been given to them. In March, 1904, Prof. Aldrich devoted a portion of Bulletin 41 of the Idaho Station, to its injuries and control. It appears that the insect gives some annoyance in parts of Southern Idaho almost every year.

In Eastern Nevada the crickets have been very common and destructive for several years. Prof. Doten, in Bulletin 56 of the Nevada Station, has given an excellent account of the life habits, and suggests remedies.

The reasons for the periodic outbreaks of the pest are unknown, but it is probable that they are mostly climatic. Springs which are favorable to the hatching of the eggs, followed by scarcity of food in mountain valleys, are doubtless important items.

Bulletin 102.

August, 1905

The Agricultural Experiment Station

OF THE

Colorado Agricultural College.

Feeding Steers

On

**Sugar Beet Pulp,
Alfalfa Hay and
Ground Corn.**

BY W. L. CARLYLE AND C. J. GRIFFITH.

**PUBLISHED BY THE EXPERIMENT STATION
FORT COLLINS, COLORADO,
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THE VALUE OF SUGAR BEET PULP, ALFALFA HAY AND GROUND CORN IN FATTENING STEERS.*

By W. L. Carlyle and C. J. Griffith.

In bulletin number 97 of this Station is given the results of an experiment which was undertaken for the purpose of determining if sugar beet pulp is a suitable foot when fed with alfalfa hay and farm grains for beef production. The results obtained were not considered final, though of importance as indicating that sugar beet pulp when fed in combination with alfalfa hay and farm grains will produce an excellent quality of beef at a very low cost.

The object of the experiment here reported was to determine more fully the comparative value of alfalfa hay, sugar beet pulp and corn, when fed singly and in various combinations to ordinary range steers.

Plan of Experiment.

In planning the experiment we had the hearty co-operation of the Fort Collins-Colorado Sugar Company, through its manager, Mr. R. M. Booraem, to whom the station is greatly indebted for many courtesies, as well as the stock, feed, corrals, labor, and all necessary conveniences for conducting the experiment.

The forty-eight steers selected for the experiment were taken from a lot that had been fed on alfalfa hay and beet pulp for some weeks, and, previous to that time, had been ranging on the beet fields and feeding upon beet tops. They were of mixed breeding,

*Other bulletins relating to the feeding of Sugar Beets and Sugar Beet Pulp have been published by the Experiment Station, and may be had on request of the Director.

73.—Part 1.—Feeding Value of Beet Pulp. Part 2.—Feeding Beet Pulp and Sugar Beets to Cows. By Buffum and Griffith, 1902.

74.—Swine Feeding. By Buffum and Griffith, 1902.

75.—Lamb Feeding Experiment. By Buffum and Griffith, 1902.

77.—Feeding Beet Pulp to Lambs. H. E. Griffin, 1902.

97.—Feeding Steers on Sugar Beet Pulp. Carlyle, Griffith and Meyer, 1905.

Shorthorn and Hereford blood predominating, and were below the average in quality. They were two years of age with one or two in each lot probably three years past. When the experiment was started on December 30, these steers averaged in weight between 950 and 960 pounds. They were divided as evenly as possible into four lots of twelve each, care being taken to have an equal number of promising and unpromising feeders in each lot. They were confined in four small corrals in close proximity to the Fort Collins sugar factory, water being provided in a large trough, a portion of which projected into each corral. The fences, feed racks and feed boxes provided for the pulp and grain were such as are used for this purpose by all feeders in Northern Colorado.

The different rations to be fed were as follows:

LOT I.—Alfalfa hay, beet pulp and ground corn.

LOT II.—Alfalfa hay and ground corn.

LOT III.—Alfalfa hay and beet pulp.

LOT IV.—Alfalfa hay.

The alfalfa hay was fed ad. libitum to the steers in each of the lots and was weighed in bulk as it was hauled to the corrals and placed in a small enclosure where it could be readily forked close to the feed rack, from which place, on the ground, it was eaten. This system of weighing the feed in large quantities accounts for the wide variation in amounts charged to the steers in the various week-periods of the experiment.

The hay was much below the average of the best Northern Colorado alfalfa hay, as it was very coarse as a rule and had been much spoiled in curing.

The pulp fed to Lots I and III was also fed ad. libitum and was placed fresh in the feed boxes or "bunks" twice each day.

The corn was of good quality, and was rather coarsely ground in a local mill, being fed in limited quantities once each day just after noon. The amount of corn meal fed was very small at the beginning, but was gradually increased. Two pounds per head was given the first week, three pounds the second week, and four pounds during the third and fourth weeks. Five pounds was given during the fifth and sixth weeks, and eight pounds during the seventh and eighth weeks, after which the amount was increased gradually until the last two weeks of the experiment, when each steer on the average in the two lots received eleven pounds daily. The amount of corn meal for each week's feeding was weighed out in advance, and approximately the same amount was fed each day, care being taken to see that all was fed out during the week, and as evenly apportioned as possible daily by measure.

The steers in each lot were weighed on Saturday of each week, the weights being recorded as they were taken.

Total Feed, Weight and Gain, With Average Weight and Gain of Each Steer.

Table I.—Lot I. Fed Beet Pulp, Hay and Ground Corn.

Date.	Pulp.	Hay.	Corn.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....				11415		961	
Jan. 7.....	9890	6815	216	13210	795	1018	66
" 14.....	6980	2580	252	12405	196	1084	16
" 21.....	5895	785	536	12490	-145	1022	-12
" 28.....	10470	580	536	12365	105	1080	6
Feb. 4.....	5890	1290	430	12940	475	1070	40
" 11.....	5230	2905	420	*			
" 18.....	8617	1000	588	13190	290	1093	23
" 25.....	7849	2475	588	13075	- 45	1090.	- 3
Mar. 4.....	6485		672	13425	350	1119	29
" 11.....	7447		672	13900	375	1150	31
" 18.....	9331	1555	750	14110	310	1176	26
" 25.....	8615	2890	840	14220	110	1185	9
Apr. 1.....	6118	1900	924	14645	425	1220	36
" 8.....	7285		924	14578	- 67	1215	- 5
Total	112117	23995	7944	14578	3163		19

*not weighed.

Table II.—Lot II. Fed Hay and Ground Corn.

Date.	Hay.	Corn.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....			11615		968	
Jan. 7.....	6530	216	12140	525	1012	44
" 14.....	2870	262	12365	235	1030	18
" 21.....	2725	336	12420	65	1035	5
" 28.....	1920	386	12295	-125	1025	-10
Feb. 4.....	3050	420	12790	456	1063	38
" 11.....	4120	420	*			
" 18.....	2430	588	12975	215	1081	-18
" 25.....	2105	588	12750	-235	1093	-18
Mar. 4.....	1005	672	12995	245	1083	20
" 11.....	1005	672	13235	290	1107	24
" 18.....	1550	856	13820	235	1127	20
" 25.....	3290	840	13565	15	1128	1
Apr. 1.....	2980	924	13725	190	1144	16
" 8.....	1940	924	13725	0	1144	0
Total	37520	7944	13725	2110		12.3

*not weighed.

Table III.—Lot III. Fed Best Pulp and Hay.

Date.	Pulp.	Hay.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....			11890		941	
Jan. 7.....	11680	5875	11950	568	968	47
" 14.....	7700	2530	12110	260	1006	21
" 21.....	9035	785	11990	-120	999	-10
" 28.....	11065	880	12050	60	1004	5
Feb. 4.....	9560	1240	12289	210	1022	18
" 11.....	5220	2305	*			
" 18.....	8617	1090	12460	200	1036	16
" 25.....	7849	685	12625	165	1052	14
Mar. 4.....	7165	1650	12735	110	1061	9
" 11.....	7447	1055	13085	300	1086	25
" 18.....	9831	945	13810	275	1109	23
" 25.....	8780	8610	13265	- 45	1105	- 4
Apr. 1.....	6113	1500	13660	825	1152	27
" 8.....	7255	1880	13500	- 90	1125	- 7
Total.....	11677	26270	13500	2210		12.1

*not weighed.

Table IV.—Lot IV. Fed Hay.

Date.	Hay.	Total Weight.	Total Gain.	Average Weight.	Av. Weekly Gain.
	lbs.	lbs.	lbs.	lbs.	lbs.
Dec. 30.....		11630		923	
Jan. 7.....	9870	12515	695	1026	58
" 14.....	8380	12480	165	1040	14
" 21.....	2465	12375	-105	1031	- 9
" 28.....	3340	12460	105	1040	9
Feb. 4.....	2320	12515	35	1043	3
" 11.....	3040	*			
" 18.....	1490	12655	140	1055	12
" 25.....	2780	12665	230	1074	19
Mar. 4.....	2546	12705	- 99	1066	- 8
" 11.....	2280	13345	460	1104	38
" 18.....	3165	12155	- 90	1066	- 8
" 25.....	4250	12940	185	1112	16
Apr. 1.....	5165	13295	- 45	1108	- 4
" 8.....	8420	13360	95	1115	8
Total.....	49795	12880	1760		10.5

*not weighed.

In tables I to IV is given the data in tabulated form of the amounts of feed eaten by the steers in each of the lots; also the gains made each week by each lot. As was the case in similar data given in bulletin No. 97, relating to the feeding of steers, there were a number of weekly weighings when the steers in each lot showed a loss as compared with the weights given the week previous. In this experiment, however, there was apparently no specific cause for the variation in the thrift of the animals. In the preceding experiment the steers in the different lots appeared to gain or lose weight in unison, but in this case there was more variation in the different lots from week to week, it being more apparent in Lot IV, in which the steers were fed only hay. The great variation in rate of gain in this lot might be accounted for by the more variable appetite of the animals when fed on a single kind of feed, while the steers in the other lots that were receiving a mixed ration

would be more likely to have a greater relish for their food at all times.

It will be observed that the steers in Lot I that received a mixed ration composed of pulp, alfalfa hay and ground corn made an average weekly gain of 19 lbs. during the experiment, or an average daily gain for each steer of 2.7 lbs. The steers in Lot II receiving alfalfa hay and ground corn, the amount of the latter feed being exactly the same as was received by the steers in Lot I, made a gain of but 12.6 lbs. per week, or an average daily gain of but 1.8 lbs., a difference of .9 of a pound in the average daily gain of each steer. The steers in Lot III, receiving pulp and alfalfa hay, made an average weekly gain of 13.1 lbs., or an average daily gain of 1.9 lbs., and received no grain of any kind during the experiment.

The steers in Lot IV that received nothing but alfalfa during the entire experiment made an average weekly gain of 10.5 lbs. or an average daily gain on each steer of 1.5 lbs.

For this experiment, the prices charged for feed were such as the average feeder paid in the vicinity of Fort Collins, viz., alfalfa hay, \$5.00 per ton; corn, 85 cents per cwt., and beet pulp at 50 cents per ton. The pulp was received from the sugar factory at a cost of 35 cents per ton. As there is much more labor entailed in feeding steers on pulp than where alfalfa hay and ground corn only are fed, we charged the pulp up to the steers at 50 cents per ton, allowing 15 cents per ton above market price for the difference in cost of labor in feeding pulp over the cost of labor in feeding hay and corn.

Table V.—Average Amount Feed Required for One Pound of Gain, and Cost of the Same.

	FOOD FED.			COST.
	Alfalfa.	Pulp.	Corn Meal.	
	lbs.	lbs.	lbs.	cts.
Lot 1.....	7.59	85.45	2.51	4.22
Lot 2.....	17.78		8.76	7.68
Lot 3.....	11.89	52.88		4.28
Lot 4.....	28.29			7.04

In table V is given the data showing the amounts of the various kinds of feed required to produce a pound of live weight gain on a rather rough bunch of steers rising three years old. From this table it will be seen that in case of Lot IV it required 28.29 lbs. of alfalfa hay, below the average in quality, to produce one pound of gain. With an average lot of good feeding steers, and alfalfa hay of good feeding quality, the indications are that one pound of gain would be produced for each 25 lbs. of alfalfa hay on the average.

When beet pulp ad. libitum was added to the ration of alfalfa hay in the case of Lot III, the amount of the latter required for a

pound of gain was reduced to 11.89 pounds, the steers requiring 52.83 pounds of beet pulp to replace 16.4 pounds of hay in producing a pound of gain. In other words 3.22 pounds of beet pulp when fed to steers in combination with alfalfa hay are equivalent to one pound of hay in feeding value, when the hay is fed as the entire ration. With alfalfa hay selling at \$5 per ton, beet pulp is therefore worth 1.59 cents per ton to combine with alfalfa in the production of beef.

By adding ground corn to the ration of alfalfa hay in the case of Lot II, it will be seen that 3.76 lbs. of ground corn when added to the ration of alfalfa hay resulted in reducing the amount of hay required for one pound of gain from 28.29 lbs. to 17.78 lbs., the steers in this lot requiring 3.76 lbs. of ground corn to replace 10.51 lbs. of hay in producing a pound of gain. In this case 3.76 lbs. of corn was equivalent to 10.51 lbs. of hay, or one pound of corn was equal in feeding to 2.8 lbs. of hay when fed in conjunction with a ration of alfalfa hay in fattening steers. With alfalfa hay selling at \$5 per ton, ground corn, according to the results of this trial, should be worth at least \$17.85 per ton, which indicates that corn at 85 cents per hundred could be fed with practically equal profit with alfalfa hay at \$5 per ton.

In Lot I, where both ground corn and beet pulp was added to the hay ration, it will be seen that the amount of hay required for a pound of gain was reduced to 7.59 lbs., this reduction being accomplished by the use of 35.45 lbs. of pulp and 2.51 lbs. of ground corn. We have seen from the comparison of nutrient values in pulp and hay, in the case of Lots III and IV, that one pound of hay was equivalent to 3.22 lbs. of pulp, and from the data in the case of Lots II and III, that one pound of corn was equivalent to 2.8 lbs. of alfalfa hay, consequently by reducing the amounts of pulp and corn, fed in conjunction with hay to the steers in Lot I, to their equivalent in hay, we should find, other things being equal, that this, together with the hay fed to Lot I, should equal the amount of hay required by the steers in Lot IV for the production of a pound of gain.

It has been shown that 3.22 pounds of pulp equaled one pound hay; therefore 35.45 pounds of pulp is equal to 11 pounds of hay. We have also seen that one pound of corn is equal to 2.8 pounds of hay, therefore 2.51 pounds of corn is equal to 7.03 pounds of hay. The steers in Lot I therefore had the equivalent of 11 pounds of hay in the pulp fed them, and the equivalent of 7.03 pounds of hay in the corn fed, which, together with the amount of hay actually fed, amounting to 7.59 pounds, makes a total of 25.62 pounds of hay required for one pound of live weight gain. Since the steers in Lot I required 28.29 pounds of hay for one pound of gain, we therefore have a balance of 2.67 pounds of hay or 9.43 per cent. as the amount saved by feeding steers a combination of feeds rather than one kind singly.

Table VI.—Showing the Average Weights and Gains. Also the Average Amount of Feed Eaten and the Average Cost per Head for 100 Days.

	Average Weight at Beginning.	Average Weight at End.	Average Gain Made.	FOOD FED PER HEAD.			Cost of Feed Per Head.
				Alfalfa.	Pulp.	Corn Meal.	
Lot 1.....	951	1215	263	1999	9343	662	\$12.95
Lot 2.....	968	1114	176	3137		662	13.48
Lot 3.....	941	1126	184	2189	9729		7.90
Lot 4.....	968	1115	147	4149			19.52

Table VII.—Selling Price of Each Lot and Average Weight and Price of Each Steer at Denver,

			Average Weight.	Average Price.
Lot 1.....	12 head, 13,890 lbs. at \$5.15 per cwt....	\$718.29	1157	\$59.44
Lot 2.....	9 head, 10,080 lbs. at \$5.15 } \$5.06	660.83	1087	56.06
Lot 3.....	3 head, 2,980 lbs. at \$4.75 }	680.00	1049	51.06
Lot 4.....	12 head, 12,800 lbs. at \$5.00 }	603.07	1062	50.25
	9 head, 9,820 lbs. at \$4.80 } \$4.72			
	3 head, 2,930 lbs. at \$4.50 }			

In Table VI may be seen the average weight of each steer in the different lots at the beginning and close of the experiment, and the average amounts of the various kinds of feed eaten per head and the cost of the same. This table should prove of value to the prospective feeder, since from it by bearing in mind that the figures represent an average of 12 steers in each case, and that the time covered was just 100 days, it should be an easy matter to get a very close estimate of the amount of feed required for a lot of steers for any stated period; also the approximate amount of feed that will be required.

In Table VII is given the data gathered from the marketing of the steers. They were shipped to Denver and sold on the open market to the highest bidder. It is only fair to state here that none of the buyers in the yards knew anything of the kinds of feed given the different lots. It will be seen that Lots I and II sold for the same price with the exception that three steers from Lot II were cut back and were valued at 35 cents per hundred less than the rest of the lot. All of the steers in Lot III sold for the same price, while of those in Lot IV, three were cut 30 cents per hundred. It has been a noteworthy fact through the entire experiment that the steers in the pulp fed lots were more uniformly thrifty than those that had no pulp.

FINANCIAL STATEMENT.**Table VIII.—Lot I.**

11,415 lbs. at 3c.....	\$342.45
23,995 lbs. Alfalfa at \$5.00 per ton.....	59.98
112,117 lbs. Pulp at 50c per ton.....	28.02
7,944 lbs. Corn at 85c per cwt.....	67.72
Labor.....	39.00
Freight.....	14.44
Yardage.....	3.00
Feed at Stock Yards.....	8.40
Total cost.....	\$563.01
Sold for.....	715.33
Profit.....	\$152.32
Profit per head.....	12.60

Table IX.—Lot II.

11,680 lbs. at 3c.....	\$348.60
37,520 lbs. Alfalfa at \$5 per ton.....	93.80
7,944 lbs. Corn at 85c.....	67.72
Labor.....	39.00
Freight.....	14.44
Yardage.....	3.00
Feed at Stock Yards.....	8.40
Total cost.....	\$574.96
Sold for.....	660.67
Profit.....	\$ 85.71
Profit per head.....	7.14

Table X.—Lot III.

11,290 lbs. at 3c.....	\$338.70
26,270 lbs. Alfalfa at \$5 a ton.....	65.67
116,757 lbs. Pulp at 50c a ton.....	29.18
Labor.....	39.00
Freight.....	14.44
Yardage.....	3.00
Feed at Stock Yards.....	8.40
Total cost.....	\$498.39
Sold for.....	630.00
Profit.....	131.61
Profit per head.....	10.97

Table XI.—Lot IV.

11,620 lbs. at 3c.....	\$348.60
49,795 lbs. Alfalfa at \$5.00 a ton.....	124.48
Labor.....	39.00
Freight.....	14.40
Yardage.....	3.00
Feed at Stock Yards.....	8.40
Total cost.....	\$537.88
Sold for.....	603.07
Profit.....	\$ 65.19
Profit per head.....	5.43

Tables 8 to 11 inclusive give a very complete financial statement for each lot of steers. While it is not the primary object of these experiments to make them financially successful, yet it is gratifying to learn that in all cases and with all kinds of feed rations, there is a fair margin of profit which is certainly encouraging to the general feeder in Colorado.

SUMMARY.

Table XII. — Giving Data for an Average Steer in Each Lot

	Lot 1.	Lot 2.	Lot 3.	Lot 4.
Weight at beginning of experiment (lbs.)	951	988	941	968
Value at 3 cents per pound	\$28.53	\$29.01	\$28.25	\$29.01
Cost entire period, 100 days	\$12.95	\$13.44	\$ 7.00	\$10.89
Cost of feed for 100 lbs. gain	\$ 4.60	\$ 7.68	\$ 4.29	\$ 7.04
Cost of labor in feeding	\$ 8.25	\$ 8.25	\$ 3.25	\$ 8.25
Weight finished steer at feed lots (lbs.)	1214	1144	1125	1115
Sale weight of steer at Denver (lbs.)	1157	1088	1060	1062
Shrinkage in shipping (lbs.)	57	56	75	53
Selling price per hundred pounds	\$ 5.15	\$ 5.06	\$ 5.00	\$ 4.78
Value at selling price	\$59.58	\$55.05	\$52.25	\$50.25
Cost of marketing	\$ 2.15	\$ 2.15	\$ 2.15	\$ 2.15
Net profits.	\$12.70	\$ 7.16	\$10.97	\$ 5.41

In Table XII is given a complete summary showing the average of each steer in the various lots. In this table is given very complete data covering the various points of comparison in the results obtained with the average steer in each lot.

CONCLUSIONS.

1. An average "feeder" steer two years old will make a gain of 1.5 lbs. per day on alfalfa hay alone, and will require approximately 28 lbs. of hay to make one pound of gain.

2. The addition of ground corn to the ration of alfalfa hay will increase the daily gain, increase the market price of the steer by finishing him better in a given time, and will add to the profits if the corn can be procured below 90 cents per hundred pounds.

3. A pound of ground corn is equal in feeding value to 2.8 lbs. of alfalfa hay and to 9 pounds of sugar beet pulp for feeding two-year-old fattening steers.

4. Sugar beet pulp at present prices is a cheaper and better feed than ground corn when fed with alfalfa hay for fattening mature steers.

5. That 3.22 of beet pulp is equivalent in feeding value to one pound of alfalfa hay, when fed in conjunction with the hay, giving two-year-old steers all they will eat of both feeds.

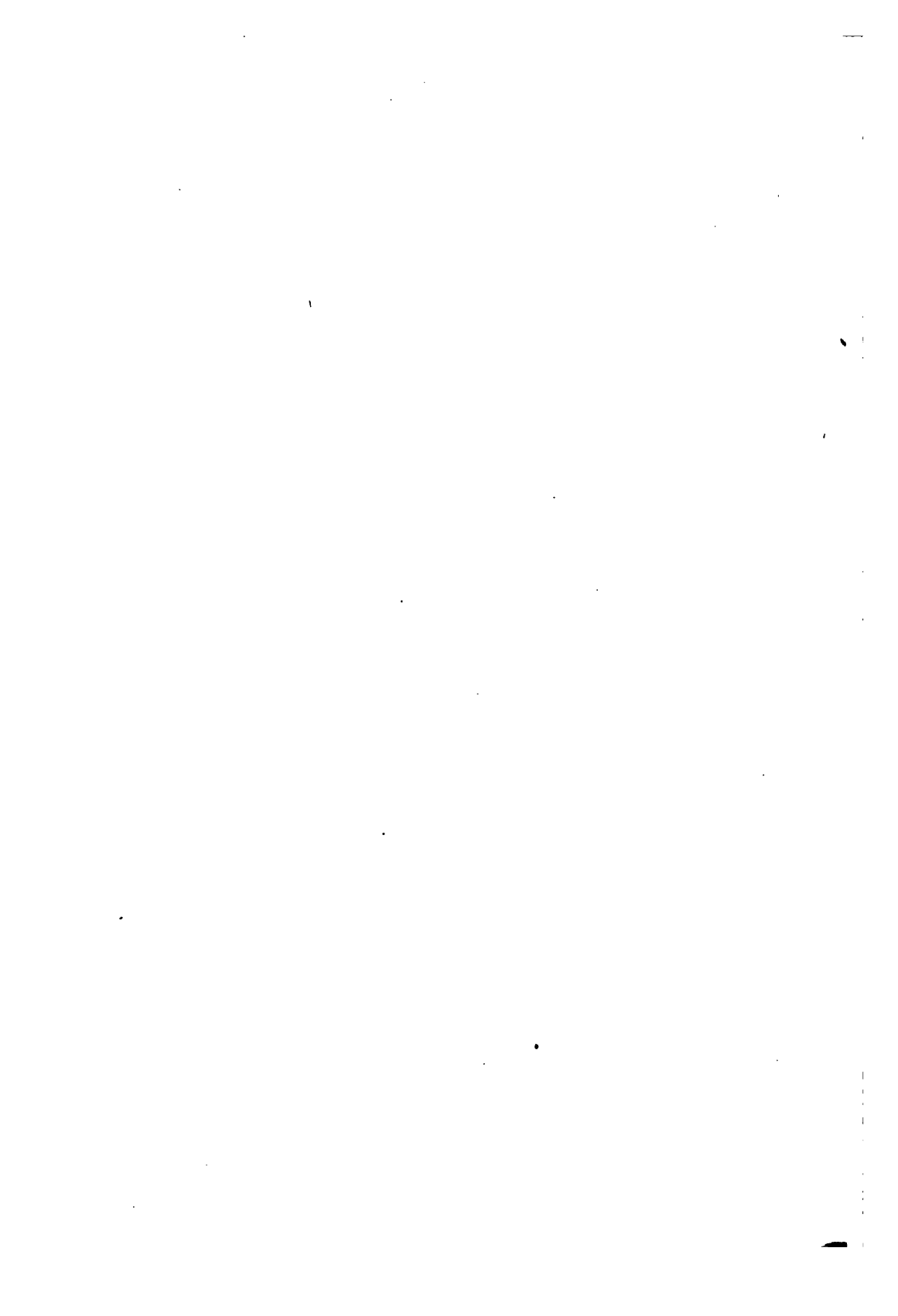
6. With alfalfa hay at \$5 a ton, it will pay to feed a light ra-

12 FEEDING STEERS ON BEET PULP, ALFALFA HAY AND CORN.

tion of ground corn with the hay, provided the corn can be purchased at from 85 to 90 cents per hundred weight.

7. With poor alfalfa hay at \$5 per ton, sugar beet pulp is worth \$1.50 per ton to combine with the hay for fattening mature steers.

8. Fattening steers will gain approximately a pound a day more on a ration composed of alfalfa hay, ground corn and beet pulp than they will on a ration made up of alfalfa hay and ground corn or on a ration composed of alfalfa hay and sugar beet pulp, and they will gain almost one and a half pounds more each day on the above ration than when fed alfalfa hay alone.



Bulletin 103.

October, 1905.

The Agricultural Experiment Station
OF THE
Colorado Agricultural College.

The Thorough Tillage System
for the Plains of Colorado.

BY W. H. OLIN.

The Agricultural Experiment Station.

FORT COLLINS, COLORADO.

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The Thorough Tillage System for the Plains of Colorado.

BY W. H. OLIN.

I. THE PRINCIPLES OF SEMI-ARID FARMING.

Regions having an annual rainfall of less than twenty and more than eight inches are usually considered as semi-arid. To successfully grow crops in such regions requires a careful study of soil and climatic conditions, with a selection of crops as nearly adapted to these conditions as possible. Even when all requirements are seemingly met, a failure is sometimes the only result. Experience, and experiments already conducted in many parts of our nation's semiarid belt, demonstrate that the preparation of a soil reservoir of good depth several months before seeding, the thorough culture of this ground before and after seeding, the selection of suitable varieties of crops, the seed of which is grown under dry farming conditions, are essentials which very largely determine success in farming lands in Colorado where irrigation can not be practiced.

The preparation of the soil reservoir and seed bed calls for careful plowing, harrowing and sub-surface packing.

1. **PLOWING.**—Jethro Tull nearly two centuries ago said "Tillage is manure." Roberts' Fertility says that stirring and mixing the soil is the one fundamental labor of agriculture. The object of plowing should be to pulverize the soil, making it possible to prepare a good seed bed for the reception of the various farm seeds. The depth to plow must depend upon the time of plowing, the character of the soil and the crop to be grown.

Shallow plowing is preferred for shallow soils underlaid by an inferior sub-soil lacking in plant food. Spring plowing for early crops should not be as deep as fall plowing for the same crops. Experiments have shown that deep plowing of stiff or clayey, adobe land in the spring turns up unworked or new soil in which most of the plant food is not available, on account of the mechanical condition of the ground. Crops on lands thus plowed often make an unfavorable growth. It is nearly always desirable to plow sandy and sandy loam soils deep, since the plant food contained in these soils is easily available and the deep plowing brings more plant food to the surface for the tender young plant to feed upon, giving it a sturdy growth at the start.

All deep plowing is best done in the summer or fall. This permits the weathering of the soil, through the fall and winter, making its mechanical texture more desirable and the plant food available. Deep plowing assists water to percolate or pass through to lower depths. Hence it increases the water holding capacity of the soil, a most important element in semi-arid farming. The deeper the plowing the greater the soil reservoir. Experiments conducted at the Cornell Experiment Station, New York, by Dr. Roberts show that an acre of average soil in good tilth will hold 20 to 25 per cent of moisture and not be too moist for cultivation. It is estimated that an acre of soil 12 inches deep will weigh 1,800 tons if it contains 20 per cent of moisture, 1,620 tons if it contains 8 per cent of moisture—the amount upon which plants are able to grow and maintain themselves. Dr. Roberts says that an inch of rainfall brings to each acre 113 7-16 tons of water. If this could all be retained in average soil it would mean almost 7 3-5 per cent moisture, nearly enough to maintain plant growth. Well fined soil is capable of taking up two inches of rainfall in the first foot of soil and still be in good condition to cultivate. Suppose that this soil is deeply plowed and contains 15 per cent moisture; an inch or a two-inch rain would find the soil reservoir able to hold it. If this ground were shallow plowed, say four inches, an inch rain would saturate the reservoir, while a two-inch rain would overflow the soil reservoir, causing a loss of water and severe washing away of the surface soil. Deep plowing therefore increases the storage capacity of moisture in our soils from which the plant draws as it has need.

Good plowing gives a clean-cut furrow on side and bottom. It turns the inverted furrow slice upon edge in a moderately well pulverized condition with but few air spaces at the bottom edge of the furrow slice. A good coulter lessens draft and aids in making a clean cut furrow. Disking the ground before plowing is advantageous but increases the expense of preparing the seed bed.

A seed bed from one to three inches deep can be prepared without plowing. The young plants may grow sturdily at first, but if the soil is not in a physical condition to store the moisture necessary to dissolve the plant food and render it available for the growing plant, lack of nourishment will bring it to an untimely end and the crop will prove a failure. Very successful crops are grown this way, when the moisture is supplied by ditch or sub-irrigation but it is always hazardous to attempt cropping without thorough tillage, under semi-arid conditions.

A disc plow will often leave the soil in a good condition for the harrow, when the ground is too hard for a mold board plow to do satisfactory work. The drier the ground the more narrow

should be the furrow, whether the plow be a mold board or a disc plow.

2. **HARROWING THE GROUND.**—Harrowing is the process of stirring the soil by some form of a toothed or circle knife implement. Its purpose is the pulverizing of the soil, reducing it to finer tilth than the plow left it, filling the interstices left by the plow and thus leveling the soil. I believe that the spike toothed harrow is a superior implement for pulverizing after the plow. It should follow as near after the plow as possible so as to prevent loss of moisture by evaporation from the newly plowed earth and the formation of clods. Each half day's plowing should be harrowed that same half day in which it is plowed.

Ground that is harrowed first lengthwise with the plowing will retain its moisture better, since it regularly and evenly fills the interstices or openings at the bottom edge of each furrow slice. Always first harrow lengthwise and later cross harrow if the ground is not in fine enough tilth for the seed. Ground that is inclined to be cloddy should be worked with the disc harrow instead of the spike tooth, double disking or half lapping lengthwise with the furrows. See that your disc is the proper size to do the most effective work in pulverizing the soil. A fourteen to sixteen-inch disc generally pulverizes better than an eighteen or twenty-inch disc, and the draft is correspondingly greater. Experiments seem to indicate that the smaller diameter discs are better adapted for farming conditions on the Colorado plains than the larger diameter discs. Experiments conducted by experiment stations and by Mr. H. W. Campbell of Lincoln, Nebraska, show that disking grain ground after the harvester prevents loss of moisture on stubble ground through too rapid evaporation, and prepares the ground for the ready absorption of rain.

3. **SUB-SURFACE PACKER.**—This tool consists of a series of wedge faced wheels attached to a common axle. These wedge-faced disks are 18 inches in diameter and placed vertically on the shaft 6 inches apart. This machine is better than a smooth roller for a roller firms the surface soil with little or no effect upon the under or sub-surface soil. The packer firms the soil in the lower portion of the furrow slice, restoring the capillarity where plowing had arrested it. This firmed under-surface soil is enabled to draw moisture from below and give good normal root development. In case a sub-surface packer is not obtainable, a corrugated roller can be used. It firms the ground but not to the depth which the sub-surface packer does. These packers should be followed by a smoothing harrow to produce an earth mulch which shall arrest capillarity and thereby check evaporation.

A spike toothed harrow with lever attachments for regulating

the angle of the teeth is a very satisfactory implement for this purpose.

4. **SUMMER CULTURE.** *Fallowing Ground*—leaving the land without a crop for one or more seasons—was a common practice with the ancients. Dr. Roberts in his work on "Fertility of the Land," says this was a necessity for them. The imperfect tools then used made but a small proportion of the plant food in the soil available and the demands of the crops grown soon outran the obtainable plant food. Then the only method for renewal was to let the soil "weather out" enough plant food, with the decayed vegetable matter to sustain another crop. Some centuries later the French found that "manoeuvring" the land—causing the particles of earth to change place by tillage—made it more productive. Experiments now show that summer tillage in our semi-arid lands has an added value—it conserves the moisture while it renders more plant food available. Good results have been obtained in Eastern Washington, Eastern Oregon, Utah and many sections of Colorado from summer culture of the land every other season. It has been found that in this way sufficient moisture can be stored from the year's rainfall to mature a crop, in many localities.

After the snows of winter have melted in the spring, plow the ground at least seven to eight inches deep. Level this down with the harrow and packer, following this process with a smoothing harrow, forming an earth mulch to check evaporation. This mulch should not be too fine as the winds of the plains will tend to rift the soil, or blow the earth mulch *entirely* away. If possible, stir the surface soil from two to four inches every ten to fifteen days throughout the summer. Allow no crust to form after summer showers, as this will increase the evaporation of the soil moisture. Keep the ground clean—free from weeds.

If fall grain is to be sown it is advisable to drill in the grain, as this insures getting it below the earth mulch which is really a dry earth blanket used all summer to hold the moisture in the soil below. Get the seed into this moist under-soil where it can have the moisture so essential for germination. It is advisable to seed fall grain not later than the last week in September in the lower altitudes and not later than the first week in September in the higher altitudes; better still, the third or last week in August.

Ground that has been well cultivated for several years will produce two crops in succession and can be given summer culture the third year. In this way it is possible to grow two crops in three years.

If a farmer expects to cultivate 80 acres he should divide it into two crop divisions—cropping 40 acres the first year and giving summer culture to the other 40 acres. This gives him a crop

on one half his land each year while he is storing up moisture in the soil reservoir of the other half to make the next year's crop. Farmers in the southern part of Larimer County, Colorado, have been able to raise quite satisfactory wheat, barley and forage crops by following this method of cropping.

Mr. Geo. D. Porter living at Akron, Colorado, near the center of the plains region has used this method of cropping, for a small area, for several years. He reported last fall, when he seeded his winter wheat, a soil reservoir in which there was five feet of moisture. Last season gave us an unusual amount of rainfall but this summer culture has been practiced in some parts of California for more than forty years with satisfactory results. The writer knows of one section of California where it seldom rains from April to September, yet here some of the finest fruit and grain is grown. This region in California has an ample supply of moisture in the rainy season—the winter months. This illustration is simply given to show the value of the earth mulch in holding the moisture which is already in the soil reservoir.

Mr. S. S. Peterman has a cherry orchard near Fort Collins that has never been irrigated. He depends upon rainfall for his moisture in a region that averages scarcely fifteen inches per annum. As soon in the spring as possible he cultivates his orchard and continues to stir the ground until the fruit sets. His trees bear fine flavored cherries in a satisfactory quantity, while his orchard is the cleanest one in his neighborhood. This orchard is eight years old, but has not yet weathered one of our "dry" years.

Summer culture keeps the ground in good tilth, keeps down weeds, renders the plant food easily available for the next year's crop, while it stores up the moisture so necessary to the plant in assimilating its food.

II. SELECTION OF SEED FOR SEMI-ARID CONDITIONS.

Climatic conditions are believed to have an influence on the development of certain temperaments and characteristics in the breeding of live stock, although the hereditary power of a well-bred horse, cow or sheep to transmit its qualities to its descendants is the major influence and measures the value of a pedigree.

While plants, like live stock, certainly have strong hereditary power, yet it seems true that climate, soil and cultural methods, have an influence on the manner of growth of very many crops grown in our fields.

M. de Candolle, an eminent plant scientist, has succeeded in finding the wild forms of one hundred and ninety-three of the two hundred and seventy species of cultivated plants. Of the remaining seventy-seven, twenty-seven he names as possibly half

wild and the rest he has so far failed to discover in the wild state.

Darwin in his investigation of domesticated plants came to the conclusion that in cases similar to this the cultivated plant either was so changed in its growing habit by its new environment that its wild prototype could not be recognized or that its original parent ceased to exist.

Prof. A. M. Ten Eyck of Kansas in an address on "Plant Adaptation" before the Corn Breeders' Association of that state last March stated:

"From a single, comparatively valueless, primitive wild form have originated in the course of time thousands of valuable varieties of plants, all differing from the original and some to such an extent that they cannot be recognized."

Prof. W. M. Hays, in the Minnesota Experiment Station Bulletin No. 62, speaking of variations in individual wheat plants says:

"Among the four hundred plants of McKendry's Fife for example, plants were found which matured in ninety-seven days, others requiring one hundred twenty-seven days. Among Power's Fife (wheat) plants, the range was from ninety-eight to one hundred seventy-two days; and among Haynes' Blue Stem plants the range was from ninety-nine to one hundred twenty-eight days.

"The ten plants which appeared to the eye as the best yielding plants out of the four hundred of each variety, were harvested and notes taken as to the height of plant, number of spikes, length of spikes and yield of shelled grain. The following table shows the extremes of the variation in each case:

VARIATION AMONG BEST TEN OUT OF FOUR HUNDRED
WHEAT PLANTS.

Name of Variety.	Height of Stalks. inches.	Length. of Spikes. inches.	No. of Spikes.	Yield in grams.
Haynes' Blue Stem.....	31 to 39	4 to 4½	19 to 31	15.4 to 19.4
Powers' Fife.....	27 to 33	3½ to 4	18 to 33	3.4 to 13.8
McKendry's Fife.....	30 to 33	3½ to 4	22 to 33	6.8 to 16.7

In breeding corn, the writer has observed that individual plants in the same breed or type of corn, vary widely in producing power, height of ears on the stalk, height of stalk, width and number of leaves and period of maturity of corn. The Iowa Seed Company state their earlist maturing type of dent corn—Farmers' Reliance—was developed by selecting the lowest ear on individual plants, these ears usually ripening first. At the Kansas station a pure bred type of corn known as Reid's Yellow Dent, was planted in the season of 1903—an ear to a row. These ears were carefully selected for uniformity and trueness to the breed characteristics of that type of corn. The resulting harvest from these different rows showed almost as much difference in the character of plants in different rows as in different supposedly fixed types of yellow dent corn, while difference in yield between highest and lowest was nearly four hundred per cent. The very best ears from the best yielding and most desirable mother ears were selected for the mother ears

of 1904 and seeded a row to an ear. Marked differences in growing habit were noted, but differences in yield from lowest to highest was but a trifle more than eighty per cent—one fifth what it was the preceding year.

"Selection is the process by which new varieties are fixed. Artificial crossing may be used to induce variation, with a view to promote the development of new forms, but selection is always the final process by which new varieties are established and maintained.

"Three principal factors largely determine the value of a variety of any cultivated crop, namely, yield, quality and adaptation—and the last named is really the deciding factor which determines whether a variety type may be successfully grown in any locality. In no two countries, perhaps in no two sections of the same country or state, are the plants subject to exactly the same conditions of soil and climate. One section may have a different soil, a little more dry weather, and the plants of this section vary to adapt themselves to these conditions. If the plant is removed from its native habitation and planted in a different part of the world or country, in a different soil, surrounded by different conditions to those to which it has been accustomed, it is placed at a disadvantage, it is exposed to a new environment to which it is not suited. Thus we can understand why a good variety of fruit or grain does not always give as good results in all places, and we should expect a variety of plants originating from the plants of a certain region to be best adapted for growing in that region, or such plants may be adapted for growing in any region having similar conditions of soil and climate.

"We find a demonstration of this principle in the fact that wheat and other grains, brought from the steppes of Russia and Turkey are well adapted for growing in the western plains region of the United States, which has a climate and soil very similar to that of the countries named. The Turkey Red wheat, for instance, has largely replaced all other varieties of winter wheat grown in the West, because of its greater hardiness and productiveness, and yet some of the varieties which it has succeeded had been grown in the West for many years and seemed to be fairly well adapted to western climatic and soil conditions. This superior hardiness and adaptation which the Russian and Turkey varieties of grain appear to have in our western country may be largely credited to the centuries of training which these varieties have had in an environment almost identical with that of similar latitudes in the West, while the varieties which the Russian grains succeeded as a rule have been those which have been gradually moved from the Eastern and Middle states farther west, and although many of these varieties have gradually become more or less hardy and fairly well adapted for growing in our western climate, yet, in the comparatively short period during which they have been grown under western conditions, apparently they have not become so hardy and well adapted to those conditions as the Russian and Turkey varieties." (Prof. Ten Eyck's Plant Adaptation.)

For more than ten years Mr. Robert Gauss of Denver, has been growing a certain type of wheat, under drouth conditions with results that are in accord with statements made by Prof. Ten Eyck. Each year Mr. Gauss has made his seed selections looking toward the seeding of wheat for the plains, that has good drouth resisting qualities.

This past season the writer seeded some of this wheat, in May, on the very driest seed bed which he has ever used. It was sown broadcast, and seed covered with a spike toothed harrow. The seeding was done on an experimental plat located on the C. F. & I. grounds five miles southwest of Pueblo, Colorado. This wheat

matured when barley and oats, seeded at the same time, in the same seed bed, perished from lack of moisture. Mr. Gauss tells me he can trace this wheat as a drouth resistant wheat for at least eighteen years; while his wheat has not been tested for milling qualities, his results would indicate the value of selecting seed grown under *semi-arid conditions, for semi-arid farming*. Persons coming from a lower altitude with a moist climate, often are completely prostrated on being transported to Leadville—Colorado's "Cloud City," nearly two miles above sea level.

In a similar manner, but probably not to so marked a degree, altitude and climate affect our crops and we should try to secure acclimated seed or at least obtain seed from regions with similar climatic and soil conditions. Seed corn from the Mississippi river states cannot be expected to make a sturdy growth in eastern Colorado; seed wheat from near tide water cannot be expected to make a quick, rapid growth at an altitude of 8,000 to 10,000 feet.

Colorado farmers find grain of good quality grown and developed in the region of their farms gives best results and Colorado grown seed should be so selected that it shall take precedence of all other seed on our home markets.

Mr. A. H. Danielson, Asst. Agronomist, a few years ago decided to test selection for hardiness in winter wheat. For this test he selected a number of varieties. The ones which showed the best quality grain and gave the best yields he used as the basis for his work. The first year all were badly winter killed. From the plants which lived through and matured grain, he obtained seed and so continued for four years. This year all of his plots showed a perfect stand, while other plots not thus treated showed from twenty to thirty per cent winter killed.

The value of good vital seed is shown in an experiment conducted by Professor R. A. Moore of the Wisconsin Experiment Station with oats. He selected from two pecks of seed oats sent to him by the U. S. Department of Agriculture, 33 especially fine, large, plump kernels and planted them in a choice plot by themselves in 1899. From these plants he received sufficient seed to plant a good sized bed. The next year he began sending out seed to members of the Wisconsin Experimental Union, asking that a record of harvest and sales be kept so he could trace the progeny of his 33 oat kernels; last year (1904,) he found the harvest of the oats with a pedigree tracing back to the 33 kernels of 1899, numbered 500,000 bushels. Hardiness, quality and productiveness are to be sought for in our field crops if we would farm profitably in any region. Because of the struggle for existence in our semi-arid fields, our farm seeds should be chosen with great care and with these three essentials always in mind.

Rate of Seeding.—Because of the limited amount of moisture in the soil a limited amount of seed should be used in seeding all crops grown on semi-arid lands which can not be irrigated. If seeded too heavily there is not sufficient moisture in the soil to mature all plants and the entire crop in a very dry year is liable to “fire”—ripen prematurely. It is better to under seed rather than over seed. The rate of seeding depends so much upon the size of seed, mechanical condition of the seed bed, method of seeding and moisture—conditions that it is impossible to give the exact amount of seed which should be used in seeding the various field crops. The writer this past season carried on a co-operative experiment with a farmer testing two varieties of drouth resistant wheats on sod. One was seeded nearly twice as heavy as the other one, yet the field having the lightest seeding had equally as good a stand as the field seeded the heavier, because there were nearly twice as many kernels in a bushel and each kernel made a plant. Below is a suggestive table which may prove helpful to persons who are seeding crops for the first time on semi-arid lands. The amount of seed required is usually from one half to two thirds that which is used for the irrigated lands.

RATE OF SEEDING FOR NON-IRRIGATED LANDS.

Name.	Lbs. per Bushel.	Lbs. per Acre.
GRAIN CROPS.		
Wheat	60	45 to 60
Barley	48	50 to 60
Oats	32	40 to 60
Rye	56	35 to 50
Emmer, or Speltz	40	45 to 60
Field Corn (in hills) ... (shelled) ...	56	4 to 6
Field Corn (in drills or Hater rows).		5 to 7
Sweet Corn (in hills)		6 to 8
Sweet Corn (in drills)		10 to 15
Kafir Corn	56	4 to 5
Broom Corn	46 to 55	2 to 4
Field Peas	60	30 to 50
Field Beans	60	15 to 25
Proso	60	6 to 12
Millet	60	5 to 10
Buckwheat	50	20 to 30
Flax	56	20 to 30
FORAGE CROPS:		
Sorghum or Cane	50	8 to 25 (varies with method of seeding.)
Alfalfa	60	20 to 25
Meadow Fescue	24	15 to 25
Brome Grasses	14	15 to 25
Vetches		20 to 30
ROOT CROPS:		
Sugar Beets		10 to 15
Mangel Wurzel		8 to 12
Carrots		3 to 5
Stock Turnips		1½ to 4 (manner of seeding.)

III. CROPS FOR THE SEMI-ARID LANDS.

The amount of water required by growing crops is shown by experiments to vary with the soil, climatic conditions and the nature of the crop grown. Crops having a large percentage of water in their composition will necessarily require more moisture to produce a healthy, vigorous growth than crops with a low percentage of moisture in their composition.

Experiments to determine the best grain, forage and root crops for drouth resistant power and productiveness are now being conducted at the experiment stations in the semi-arid states. Conclusive results have not yet been obtained but the following crops are worthy of consideration for semi-arid farming. All of these have been successfully grown in some portion of the semi-arid West, but probably none of these crops would do well in all regions of Colorado where semi-arid farming is being practiced.

I. GRAIN CROPS.

1. *Corn*—Early maturing types of dent and flint varieties are chosen. Cool nights, high altitudes and short summers are not adapted to this cereal since corn is a semi-tropical plant. When the seed bed is well prepared and the crop thoroughly tilled, eastern Colorado farmers have been able to obtain from 10 to 25 bushels per acre with the average season.

Favorable seasons a greater yield is reported in a few individual cases. In raising corn in Colorado it is highly important to grow an acclimated variety. Obtain seed grown as nearly as possible under the same climatic conditions which prevail in the region where you wish to plant it. Select seed of good vital power. It is especially important in all semi-arid regions to give the crops a good start, for they usually have a hard struggle for existence, even under the thorough tillage system of farming. Hence the use of good, strong, vital seed grown under drouth resistant conditions is very important.

2. *Kafir Corn*. This is an important crop both for grain and forage. It is a non-saccharine sorghum. The seed is borne in a head at the top of the stalk and seems to be relished by all classes of stock. In tests conducted at the Kansas Experiment Station the feeding value of Kafir corn for fattening hogs was found to be 90 per cent of the feeding value of corn (Kans. Bulletin No. 128). This crop may appear almost dried up, favorable conditions return and it revives in a remarkably short space of time. It seems to withstand dry and windy periods to a remarkable degree, if these periods do not last too long.

The Fort Hays Sub-Station in Kansas, gives the following plan of seeding for grain and for forage:

"Kafir corn grown for seed does best when planted with a lister in rows from 3 to 3½ feet apart, and cultivated enough to about level the ridges. If seed alone is desired, a special plate should be used in the drill that will put a stalk every 4 to 6 inches apart. If the fodder is also sought, the seed should be much thicker. A common practice is to use the regular corn plate set to drop 12 to 16 inches apart. This will drop a dozen or more grains at a place. When planted in rows the corn harvester should be used for cutting the crop, and the bundles set up in good sized shocks. When the heads are dry they may be threshed with the ordinary thresher. The most satisfactory method of harvesting the heads is to take a low wagon with a tight rack and a good sized chunk laid across the back end, with two stakes set in it, about six inches apart at the bottom and one foot at the top, 18 inches from the chunk. One man with a heavy broadax stands on the wagon and chops the heads off, as two or three others pick up the bundles and lay them on the chunk.

"With two wagons and five men this is a very rapid way of obtaining seed. The bundles may easily be reshocked or laid in piles. The threshing of the entire stalk is not satisfactory, if the stalks are of any size. It is very hard on a machine, and the fodder does not keep so well when cut up. It also dries out, which is undesirable. The practice would be similar to cutting bread for the table a month or so beforehand. It is not palatable.

"For roughage alone, the general practice is to plant with the grain drill at the rate of a half to a bushel per acre, depending upon the land. This is cut with a mowing machine, raked, and put in large cocks. A great deal of labor can be saved by using a buck-rake or "go-devil," to bunch the windrows."

The White Kafir with a black hull or chaff is the earliest variety and so far seems to be the hardiest grower and best yielding variety.

3. *Wheat.* (A) **SPRING WHEAT.**—The best spring wheat variety for semi-arid conditions seems to be a durum wheat known as Kubanka durum—U. S. Cerealists, M. A. Carleton, introduced some 15 variety types of durum from a part of Russia with soil and climatic conditions quite similar to eastern Colorado. The type which seems best adapted to Colorado conditions is the Kubanka durum. This is a spring wheat in our latitude and should be seeded as early in the spring as ground and weather conditions will permit.

The durum wheat, having been grown for many generations in a semi-arid climate in Russia, withstands drouth conditions better than our common spring wheats. It must be remembered, however, that no wheat can be matured without some moisture. Kubanka durum has good drouth resistant power, but one must not expect this wheat to mature a satisfactory crop without several inches of rainfall during the growing season. While durum wheat has been tested this past season in thirty counties in Colorado, experiments have not been conducted long enough to tell us the minimum amount of moisture required to produce a crop under our differing conditions of soil and climate.

This wheat has the heaviest and coarsest beards found on any wheat. The kernel is very hard and most millers feel that this wheat requires special machinery for milling. For this reason but few local millers in the state are buying durum wheat. Mr.

B. F. Hottel of the Lindell Mills, Fort Collins, Colorado, ground 1,500 bushels of Kubanka durum last fall. He put up five pound sample sacks of this flour and the Agronomy Department assisted in placing these sacks in more than fifty families to be tested in both light bread and biscuits. The reports sent in from this test showed that light bread or biscuits made from Mr. Hottel's durum flour compared very favorably with the patent flour in common use, in texture, elasticity (lightness), flavor and moisture. While the bread was possibly a shade darker it was not considered a serious objection. Comparative tests made later, by the Domestic Science Department, Mrs. A. M. Hawley and Mrs. Winnie E. Olin, confirmed the previous tests, showing the Hottel durum flour made a very satisfactory bread. This wheat is also used in making semolina, a milled product from which our very best French and Italian macaroni is made. A milling firm in Cincinnati, Ohio, is now making from 8,000 to 9,000 pounds of macaroni per day from western grown durum wheat. This wheat when first introduced, was known as macaroni wheat and it was believed that it could not be used for anything else. The milling and baking tests conducted in North and South Dakota, Minnesota and Colorado, demonstrate that durum or macaroni wheat gives a desirable flour for bread or pastry. Prof. J. H. Shepard, Chemist of the South Dakota Station, has found that the importation of wheat known as Kubanka No. 5639, gives the best quality flour of all durum wheats.

This wheat should not be sown on the irrigated lands, as the use of too much water produces starchy kernels, causing the wheat to deteriorate in quality. It should not take the place of any bread wheat now being successfully grown in any region. It is recommended as a spring wheat on lands where other spring wheat does not yield a satisfactory crop, in a region where there is sufficient rainfall to mature a drouth resistant wheat, giving the farmer a semi-arid bread-wheat. Like all new crops, a market must be developed for it.

This wheat has only been grown in our state a few years and farmers are urged to study market conditions and determine their acreage of this new crop by the market demands for this wheat.

(B) WINTER WHEAT.—The variety of wheat has given the most satisfactory yields and shown drouth resistant power is Turkey Red. This wheat has been grown quite successfully in Kansas, Nebraska and portions of Colorado for many seasons. It is the wheat which made Kansas the greatest winter wheat state in the Union and is as good for the irrigated as for the semi-arid lands. The millers of Colorado prefer this to any other wheat for flour production. It has a ready and constant market at any mill in the state. Seed for semi-arid lands should be obtained from

regions where this seed has been kept pure and grown "above ditch."

The sub-stations in Nebraska and Kansas located in the western portions of these states can aid our eastern Colorado farmers to obtain seed and the Monticello sub-station farm in Utah will help our western Colorado farmers to obtain seed wheat, while the writer will also assist anyone desiring this wheat, to obtain as good seed as possible, grown under drouth resistant conditions.

Any winter wheat which has good milling quality and shows drouth resisting power, adapted to the region where grown, can and should be developed by wise seed selection and careful culture treatment.

All semi-arid wheat should be harrowed or run over with a weeder to break up the crust which may form, and thus check too rapid evaporation. Wheat can thus be advantageously cultivated until it is knee high. Often seeding rows sixteen instead of eight inches apart (stop up every other hole in the drill) is advantageous. Then one can use a beet cultivator or other small toothed cultivator and cultivate the crop, keeping the ground well stirred.

Cultivating grain in the semi-arid region lessens evaporation and thereby holds more moisture for the growing crop.

4. *Barley*.—This grain has not been generally sown as a drouth resisting crop. Bald barleys can be grown in the higher altitudes and in the northern and north central portions of the state, with a fair degree of success. Bald barley when ripe has a very hard kernel and most feeders find it best to crush or grind it before feeding to stock. Cut in the soft dough or before ripening, it is fed in the straw without threshing. A bearded feed barley is grown in some sections of the state. Obtain seed grown on non-irrigated lands.

5. *Emmer*. This grain belongs to the wheat group and is sometimes called speltz by our farmers. Both emmer and speltz have a hull which clings to the kernel and does not come off when threshed.

Speltz and emmer differ in size of head and arrangement of spiklets on the spike or head. Emmer is the more preferable grain of the two for our conditions. This is a spring grain and should be seeded the same as barley. It is used as a feed grain for nearly all kinds of stock. It is being grown more extensively in the South Platte and on The Divide east of Colorado Springs, than in any other portion of the state.

6. *Oats*. This grain is not well adapted for non-irrigated lands. Only the earlier maturing types should be grown. It is often sown for a hay crop in eastern Colorado and in higher altitudes above the ditches.

7. *Rye*. Winter rye or early varieties of spring rye are sown, for hay and for grain crops as well. Choose a market type of rye and seed a small acreage at first.

II. FORAGE CROPS.

1. *Cane or Sorghum*. This is grown for feed to supplement the range in winter. Grow early maturing types. Drilled sorghum is a more certain crop than when sown broadcast.

2. *Proso*. This is a drouth resistant millet, imported within recent years by the U. S. Cerealists, Prof. M. A. Carleton, from the driest regions of Europe. This crop grows a wealth of seed in a close paniced head, while it affords considerable forage in its broad leaved foliage. It is a spring crop, but should not be seeded until all danger of frost is passed. There are several varieties but the white proso furnishes the most foliage and fully as much grain as any other type of proso.

3. *Millet*. Mr. J. E. Payne in Bulletin No. 77 of this station, reports this as a widely grown crop with a yield varying from one quarter to one half a ton, according to season and locality. The German millet has proven one of the more desirable types to grow on account of its yield of grain.

4. *Alfalfa*. This crop is being tested in many parts of our semi-arid land. Results differ with methods of seeding, soil and the seasons. Experiments already conducted are not convincing. This is our most important perennial forage crop and the writer would ask that the following suggestions, given in Bulletin No. 90, by Mr. J. E. Payne, be noted by all who contemplate seeding alfalfa on non-irrigated land: "The important factor in getting a stand of alfalfa is getting a good seed bed for it. My experience has taught me to plow the ground early in the season five to eight inches deep, harrow until it is thoroughly packed and then wait until the ground is thoroughly wet before planting the seed. If this occurs before the middle of July go on the ground with a light drag harrow as soon after the rain as the surface appears to be dry and break the crust thoroughly." Then sow the seed with a press drill and follow with the harrow. A good stand has been obtained every time I have followed this rule. "Some have been successful with the hoe drill and some have used the press drill. One man seeded his alfalfa with a lister, taking off the shares and running the seed in behind the subsoiler part of the machine. The time to sow alfalfa may be any time when the ground is in good condition, between the 1st of May and the 1st of July. Having a stand of alfalfa, the next question is how shall it be maintained against its enemies, the drought and the grasshoppers? It has been demonstrated in west-

EFFECT OF GOOD AND POOR SOIL PREPARATION.

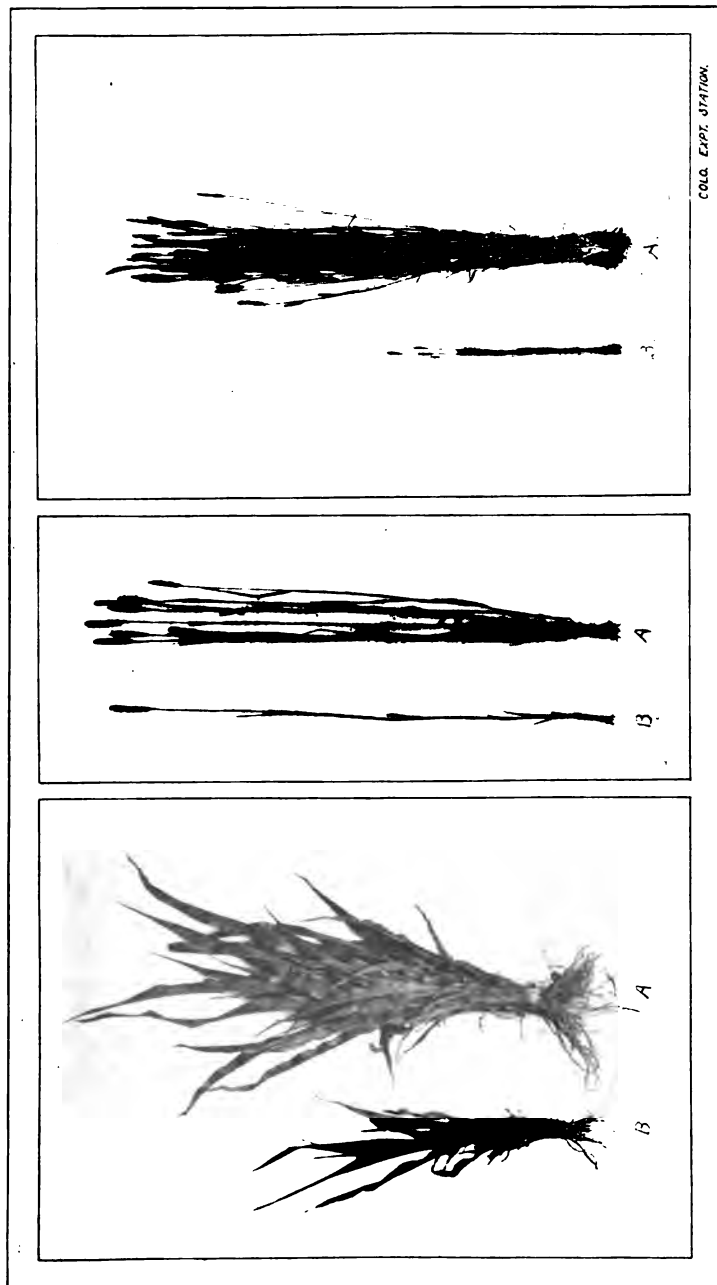
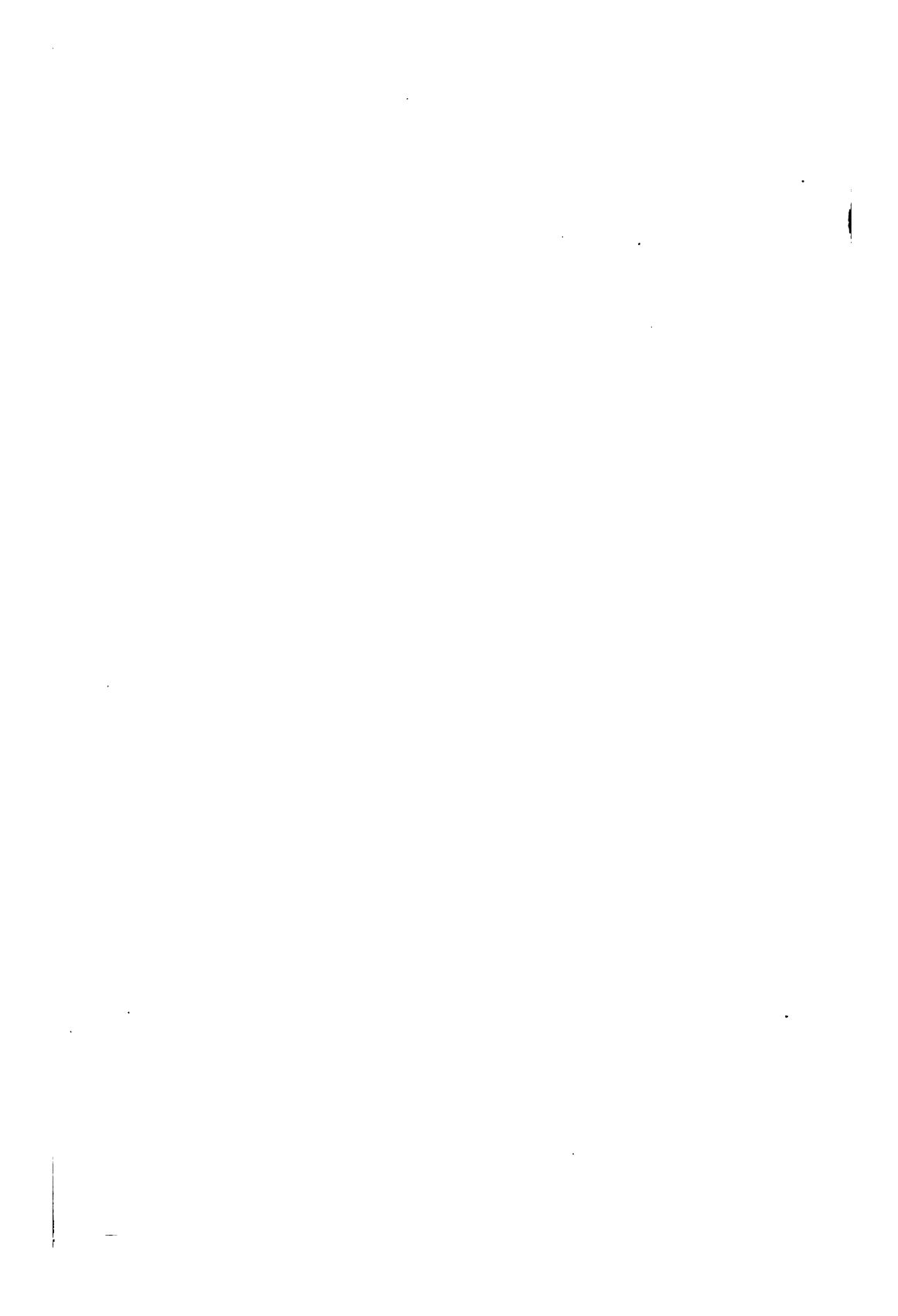


FIG. 1. One Hill Corn. FIG. 2. One Wheat Plant. FIG. 3. Ten Wheat Plants.
A. (In each Fig.) On well prepared soil. B. (In each Fig.) On poorly prepared soil.
In each case the plants are from the same seed and same field.



ern Kansas that thoroughly discing the old alfalfa field usually increases the yield of hay, while it also prevents the deposit of grasshopper eggs in the field."

Mr. H. T. Miller on a ranch near Fort Collins, has some ten acres of alfalfa above the ditch that has been seeded down twenty-eight years. He cuts two crops, and favorable years, like 1904 and 1905, he cuts three crops each year. This is located on the lower level and some years receives considerable moisture, which runs off from the higher ground surrounding the field.

Many of these "favorable locations," can be successfully found in many parts of eastern and western Colorado, where irrigation can not be practiced.

5. *Brome Grass*. There are several varieties of this grass but the one that has been the most widely tested in Colorado is *Bromus inermis*. This was first tested on the experimental grounds of the California station, being imported by Prof. Hilgard from Europe and offered for distribution to California farmers in 1884. This grass has proven to be one of our best drouth resistant grasses in Colorado. It requires a good seed bed and a reasonable amount of moisture for germination and early growth. It is one of the first grasses to appear in the spring and the last grass to die down in the fall.

6. *Meadow Fescue*. This is a grass resembling our blue grass in habit of growth, but carries a heavier sward. It is English blue grass and where seed can be obtained from non-irrigated land has made a reasonably good growth in western Kansas and Nebraska. It is of slow growth the first season, has a metallic green lustre and is better adapted for a pasture than a meadow grass.

7. *Field Peas*. This crop under ditch and sub-irrigation has made an excellent growth in many parts of our state. But few tests have been made on non-irrigated lands. These indicate that field peas can not be counted as a sure crop every season, but very often seeding early in the spring, peas will mature sufficiently for a good hay crop. Peas for hay can be cut with a mower, and well cured hay makes good feed for cattle and sheep. It is not advisable to feed this hay to horses.

III. ROOT CROPS.

Potatoes, sugar beets and rutabagas have been grown on non-irrigated lands in a few sections of the state. Root crops need considerable moisture and it will require experiments for several seasons to determine to what extent these crops can be grown on semi-arid lands in the various sections of our state.

IV. NATIVE PASTURES AND MEADOWS.

Colorado has some most nutritious native grasses. While the grass is short and sparse in many parts of our ranges, when not overstocked, it keeps the stock in excellent condition.

The hay made from native grass commands a premium in the market. Much of our very best quality hay grows above the irrigation ditches. One of our most hardy and best native hay grasses is the Western Wheat Grass (*Agropyrum occidentale*), known locally as Colorado Blue Stem. This is a leafy grass, forms an even sod, and experiments show it can be sown the same as brome grass or meadow fescue, with good success.

A farmer near Fort Collins sowed three acres of Blue Stem with a nurse crop this spring, and has a good stand of grass on cultivated ground. He sold the Blue Stem hay from a native grass meadow for five to six dollars a ton more than he could have obtained for his alfalfa hay. His native hay is always of good quality and sells from \$12 to \$16 per ton in the market.

Native meadows may be made profitable when good native hay grasses are carefully chosen. The underground stems of many of these grasses give them good drouth resisting power and causes them to thicken rapidly, making finer and therefore superior quality hay, yielding from one and one half to two and one half tons per acre. Many arroyas or lower level areas furnish favorable locations for Blue Stem meadows.

The writer will be glad to assist anyone who wishes to start a Blue Stem or Grama Grass meadow.

IV. PRINCIPLE OF CAPILLARITY.

Water in the soil used in the plant economy is known as capillary water. The water found in the bottom of postholes dug in the wet ground or standing on the surface of the ground is called ground water or free water. This free water flows under the force of gravity, as does the water in our irrigation ditches. When the ground becomes thoroughly saturated all the spaces between the grains of soil become filled with water. This cuts off all air from plants and they drown or suffocate.

Ground or free water is not in that particular form available to the plant. When it sinks into the soil and later comes up in small quantities in the capillary tubes of the soil, it is the essential capillary water which aids in dissolving plant food in the soil so the root hairs can utilize said food. Plants get all the water they use *through their roots*. When the texture of the soil is just right and the amount of moisture ample, the soil grains and granules will be surrounded by this water as a thin sheet or film. This is continuous

where the grains or granules are in contact or nearly so and seeks to extend in all directions. If a dish be filled with soil composed of grains and this soil be rounded up into a cone, one can get some conception of this capillary action of the water in the soils of our fields.

Pour water slowly into the dish and it will be observed that soon this water is drawn quite a distance upward from the base of the cone, as shown in diagram. Place two rectangular pieces of window glass in a basin of water so that two edges of the glass plates touch. It will be observed that where the edges are in contact with each other is where the water rises higher than anywhere else on the plates.



COLORADO AG. EXPT. STA.

FIGURE 4.

(From First Book of Farming.)

- a. Saturated soil-water drawn up by capillary action from bottom of basin.
- b. Dry soil.

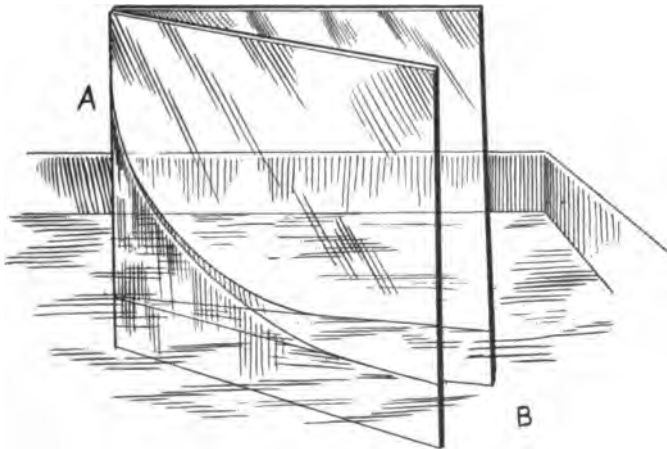


FIGURE 5.

a-b. Water line between glass plates.

This action is also clearly shown by the diagram used by many text books in physics. Place several glass tubes varying in size from a quarter of an inch in diameter to as small a tube as you can obtain, with one end of each tube in a basin of water. It will

be noticed that the water on the sides of the tubes is above the height of the water in the basin and the smaller the tube the higher will be the water on the sides of the tube.

"The force which causes the water to rise in these tubes is called capillary force, from an old Latin word *capillum*, (a hair). because it is most marked in hairlike tubes, the smaller the tube the higher the water will rise. The water which rises in the tube is called 'capillary water.'" (Goodrich's First Book of Farming).

This book of Mr. C. L. Goodrich (formerly instructor in Agriculture in Agricultural Institute, Hampton, Va.,) shows that, for their best development and growth, roots of plants must have a firm, mellow soil, a ventilated soil, a warm soil, a soil supplied with plant food and a moist soil. The following interesting diagram teaches the relative amounts of film moisture held by coarse and fine soils. Here are two tumblers, one with a half pound of coarse soil, the other with a half pound of fine, sandy loam. In a small phial is shown the amount of water necessary to cover each half pound with a film of moisture. It requires more than five times as much water for the sand as it does for the coarse soil.

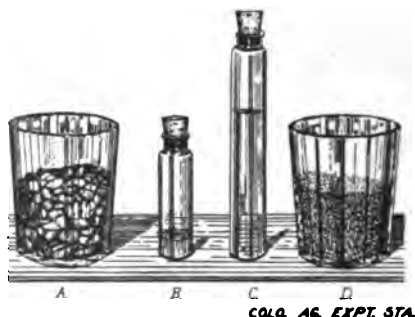


FIGURE 6.

- A. Coarse soil.
- B. Phial containing amount of water necessary to cover the coarse soil with a thin film of moisture.
- C. Phial containing the amount of water necessary to cover the fine sandy loam with a thin film of moisture.
- D. Fine sandy loam.

This shows that fining the soil increases the capillarity of the soil, its power to hold capillary water.

It has been estimated by careful agriculturists that the film surface of a cubic foot of clay loam spread out would cover three-fourths of an acre. When these capillary tubes of the soil extend to the surface the hot sun of our semi-arid lands pumps the water from them which is seemingly wasted in the dry air of these regions. The earth mulch is the dry blanket which breaks capillary connection between the under surface soil tubes and the hot outer sur-

face, checking this seriously rapid evaporation. Of course the finer the mulch the more perfect its action. Were it not for the winds on our plains, we could make a *dust* mulch and thus get the most perfect earth mulch for checking evaporation of moisture from the soil. The danger from wind blowing soil and seed from the field is too great and farmers are cautioned not to make the earth mulch *too fine*. Leave the soil as loose as possible on top, so as to prevent this capillary action reaching to the surface, but *do not* make it of *dust-like fineness*.

The blanket-like action of this earth mulch and the difficulty the water has in getting through it, is well illustrated by loaf sugar and granulated sugar. Place one of these hard squares of loaf sugar in a teaspoon and lower it so it is partly submerged in a cup of coffee. How soon it is saturated. Place the same amount of granulated sugar in the teaspoon and lower as before in the coffee and observe how much longer it takes to saturate the finely ground sugar than it did the loaf sugar. The finer flour sugar used by confectioners takes still longer for water to saturate it. A thoroughly fine, dry, dust blanket requires more moisture to wet through it, to the soil you want to reach with moisture, since the dust is so much finer and has therefore a greater film surface than the under soil. On the other hand, when moisture seeks to come up, it has the same difficulty to get to the surface of the dust blanket and be lost in the hot, dry air above, which it experiences in getting down.

For this reason our earth mulch should be kept as fine as the action of prevailing winds will permit.

Remember, capillary force will carry *down* as well as *up*, and we can deepen the root growing power of our farm crops by deep plowing and summer culture, which stores and conserves soil moisture.

V. EXPERIMENTS AND EXPERIENCE IN SEMI-ARID FARMING IN OTHER STATES.

The following questions were sent to the experiment stations in each of the western states in the semi-arid regions, where crops are being grown without irrigation.

QUESTIONS.

1. To what extent is semi-arid farming, without irrigation, practiced in your State.
2. With what success?
3. Do your best farmers under this system of farming try to obtain a crop each year from a given field, or only every other year?
4. Will you tell me what preparation you think makes the most satisfactory seed bed for semi-arid farming conditions?
5. What is your average rainfall in localities where semi-arid farming is practiced?

6. How do your farmers conserve this moisture?
7. What tools are used in doing this work?
8. What crops have proven most successful for you?
9. What yields are obtained?
10. What literature can you cite me to for information on the thorough tillage system of farming under semi-arid conditions?

The answers received from these questions show that semi-arid farming, where irrigation cannot be practiced, is now being carried on with some degree of success in eastern Washington and certain portions of Oregon, Idaho, Montana, Wyoming, California, Nevada, Utah, Colorado and New Mexico.

The reply letter from Prof. E. E. Elliott, Agriculturist at the Washington Experiment Station, located at Pullman, Washington, gives us the farm system which eastern Washington farmers have followed for several seasons quite successfully.

Pullman, Washington, June 14, 1905.

Dear Sir:

Replying to the questions in your letter of June 8th, I will make the following answers: (1.) One-third of the State of Washington is available for dry farming and a very large part of it is now under cultivation. In using the word "dry farming," I refer to agricultural operations outside of irrigation. (2.) This part of Washington is by far the most fertile and produces the largest crops in the State except those under irrigation. It is largely devoted to the culture of the different grains and embraces the famous wheat region of eastern Washington. (3.) It is the general practice to summer fallow for fall grain, a crop being produced by this means every other year. Many of our progressive farmers are trying to introduce other crops to take the place of the summer fallow in the alternate years. (4.) Probably the best preparation of the ground under the summer fallow system is to plow it in June and cultivate thoroughly throughout the season. By this means the moisture is conserved and the seeding can begin much earlier in the fall. (5.) The average rain fall throughout the semi-arid regions of this State where farming is practiced, runs from 12 to 23 inches. You will understand, however, that through part of this region the conditions for conserving this moisture are very favorable, owing to the nature of the soil. Successful crops of grain are being produced where the rain fall is as low as ten inches. Since much of our wheat is grown from fall sown crop and the greater amount of the moisture is precipitated during the winter and spring months, there is little difficulty in conserving a sufficient amount of the moisture to produce a crop, and it is rare that a failure occurs from the lack of moisture. (7.) The tools employed for cultivating the plowed ground are the common harrow used everywhere, although specially designed tools intended to destroy wild oats are coming into general use. (8.) This question is answered by question one. (9.) The yields of wheat range from 20 to 50 bushels. Oats, from 50 to 90, and barley slightly less, while rye is grown almost entirely for hay and that in the extremely dry sections. (10.) I regret that we have no literature that would be of much service to you on this subject.

Thanking you for this inquiry, I am,

Very truly yours,

E. E. ELLIOTT.

Mr. F. M. Gum and Mr. W. L. Putnam, special students in Agronomy for spring term of 1905, assisted me in preparing these questions and carrying on the correspondence. The replies which they received are hereby acknowledged:

Prof. J. H. Shepperd, Dean of Agriculture, North Dakota.

Prof. F. B. Linfield, Director State Experiment Station, Montana.
 Prof. B. C. Buffum, Professor of Agriculture, State University, Wyo.
 Prof. Luther Foster, Director Experiment Station, New Mexico.
 Prof. Lewis A. Merrill, Agronomist, Utah Experiment Station.
 Prof. T. L. Lyon, Agriculturist, Nebraska Experiment Station.
 Prof. A. M. Ten Eyck, Agriculturist, Kansas Experiment Station.
 Prof. Jas. Withycombe, Oregon Experiment Station.
 Prof. G. A. Crosthwait, Idaho Experiment Station.
 Prof. M. A. Carleton, United States Cerealist, Department of Agriculture, Washington, D. C.

These answers show that summer culture is being practiced with considerable success. This plan contemplates making the soil a reservoir to hold sufficient moisture to grow a crop every other year. The rain fall in those portions of the western states where this system of farming is practiced varies from 10 to 25 inches. Successful crops are being produced in both Utah and eastern Washington with the average rainfall near the minimum. It must be remembered that soil as well as climatic conditions quite largely determine the success of any system of farming.

Director Linfield of the Montana Experiment Station says:

"In certain sections of this State farming without irrigation is practiced quite extensively. This is particularly the case in Gallatin Valley, where from 75,000 to 100,000 acres are farmed in this way. Probably a larger area than this is farmed near Great Falls and in the Flathead country around Kalispell. There is also quite a large area cropped without irrigation in other sections and very successfully indeed. We are at present trying to encourage the extension of this method of farming in other parts of the State. Conditions look very favorable in the Bitter Root Valley, in the Judith Basin, and in the higher districts back from the Yellowstone river, both north and south. In the drier portions of the State the practice is to crop the land every second year only. In the Gallatin Valley this is particularly the case, fall wheat and fall rye being the crops. Around Great Falls and Flathead spring crops are grown and the cropping is usually every year. It will depend of course to a certain extent upon the rainfall and climatic conditions which vary considerably in the different valleys of the State.

"We have not experimented long enough to determine just exactly what preparation of the ground makes the best seed bed for dry land farming conditions. I am inclined to think that with many of our farmers their practice is not the best. Where crops are grown every year, the land must be plowed in the fall and plowed deep, then cultivated in the spring just as early as possible or as soon as the land gets dry enough to work. This working is continued until the weather is warm enough to sow the crop. The time of sowing varies from the latter part of March to the first of May, depending, of course, on the climatic conditions in the lower and higher valleys. For fall crops, the land is usually plowed in the spring and then worked down immediately with the disc and drag harrow, and cultivated frequently during the summer to conserve the moisture and then fall wheat is sown usually about the first week in September. Some sow the latter part of August. Some do not sow until the early part of October, but the earlier sowing gives the best results as a rule. The average rainfall in our best dry farm districts is about 16 to 18 inches, varying of course with the different years. In this State no special tools have been introduced for the work of cultivating. The disc and spring tooth harrow and the drag harrow are the only tools used in the cultivation of the ground.

"In the Gallatin Valley, fall wheat and fall rye are the principal crops grown on the land. Around Great Falls spring crops are more generally grown, wheat, early oats, bald barley, and spring rye. Timothy hay and

brome grass are also grown to a considerable extent, particularly the former, and alfalfa is being tried with considerable success. It seems to do well once it is well started in the ground. In the Flathead country also, spring crops are grown, but here the clover seems to do a little better than the alfalfa, although it is not a permanent crop. In the Gallatin Valley the fall wheat will usually yield from 20 to 25 bushels per acre on the average and I believe around Great Falls somewhat similar crops are obtained as the conditions are a little more favorable."

Prof. A. M. Ten Eyck of Kansas, in speaking of the tools used for preparing the seed bed in western Kansas, says:

"Disk plows are being commonly used now in western Kansas. They appear to be better adapted for plowing dry, hard land, than the moldboard plows. Other tools used are the disk harrow, common harrow and some make use of a sub-surface packer, or corrugated roller."

Prof. James Withcombe of the Oregon Experiment Stations, says:

"Replying to your letter of the 7th, beg to say we have no specific date as to wheat growing under semi-arid conditions without irrigation, in this State. There are, however, several million bushels of wheat grown annually under practically arid conditions and without irrigation.

"Precipitation in several of our wheat growing counties will range from 8 to 14 inches annually and the wheat crop in these sections will range from 15 to 35 or even 40 bushels per acre, some seasons.

"The prevailing system is to summer fallow every alternating year; in this way some of the moisture of the preceding year is conserved for the wheat crop. There is no especial system of culture developed and ordinary agricultural implements are used, such as gang plows of the ordinary mould board pattern, and the disk plow is used. The better class of farmers endeavor to work their ground down well immediately after plowing; in this way the furrow slice is thoroughly pulverized and made compact, and in this condition it conserves the maximum amount of capillary moisture.

"The soil in these sections is in excellent physical condition, being largely volcanic ash with considerable organic matter. However, the present system of farming is very injurious and in time will doubtless develop very unsatisfactory conditions for wheat production. While from 8 to 12 inches of precipitation may be sufficient to produce a good crop of wheat now, later when the organic matter becomes reduced, a great deal more moisture will be required as the soil will be less capable of retaining moisture.

"Trusting this supplies the desired information and if we can be of further assistance at any time, you will kindly advise us."

VI. AMOUNT OF MOISTURE REQUIRED BY FARM CROPS.

The amount of moisture required by the various farm crops varies with the character of the crop and the climatic conditions under which they are grown. The experiments already carried on in the agricultural stations of Europe, and the Eastern and Central States, east of the Mississippi river in the United States, show that the leading grain and root crops require from 271 to 576 pounds of water to produce one pound of dry matter under normal conditions, in a normal season.

Hellriegel of Germany and Prof. F. H. King of Wisconsin, give the amount of water to produce one pound of leading crops as follows:

Wheat	458	lbs. water.
Barley	464.1	" "
Oats	503.9	" "
Corn	270.9	" "
Clover	576.6	" "
Field Peas	477.2	" "
Potatoes	385.1	" "

The Utah Experiment Station has found that under semi-arid conditions the evaporation is such that wheat requires 750 pounds to mature one pound of dry matter.

Counting the weight of straw necessary to grow 1 bushel of wheat (60 lbs.) as 90 lbs. (1 1-2 times the weight of grain), we find that it requires 56 1-4 tons of water to produce one bushel of wheat in our climate. The moisture required to mature a crop of wheat is believed to indicate the maximum amount required by most any farm crop in the semi-arid lands of Colorado.

VII. ANNUAL RAINFALL FOR COLORADO.

The U. S. Weather Bureau has divided the state into weather districts for convenience in making and recording reports. The average annual and crop season rainfall in these several districts is indicated on the chart given below. These averages are made from the government reports and cover the period observations have been made. The minimum is six and the maximum thirty-seven years. Through the courtesy of Mr. F. H. Brandenburg, District Forecaster for the Rocky Mountain District, we are enabled to give this valuable data on the rainfall by districts.

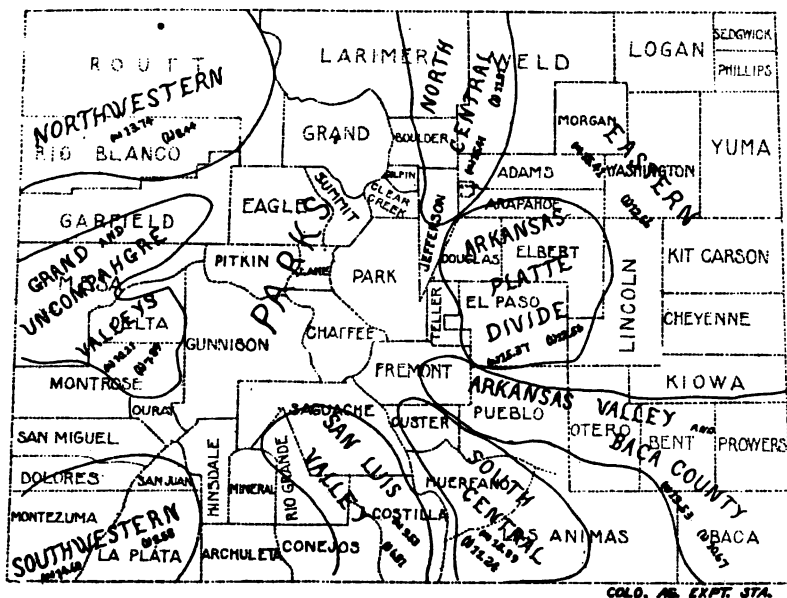


FIGURE 7.

a. Average annual moisture precipitation.

b. Average precipitation February to August.

Weather districts are marked by full lines and county limits by dotted lines on the chart.

Station normals, with the number of years weather records have been taken, are as follows:

I—NORTH CENTRAL DISTRICT.

	No. Years.	Average Annual. Precipitation Normal.
1. Alford	10	17.75 inches.
2. Boulder	9	17.20 "
3. Boxelder	13	17.14 "
4. Denver	33	14.49 "
5. Fort Collins	25	14.47 "
6. Greeley	14	11.76 "
7. Laporte	14	14.97 "
8. Waterdale	10	15.47 "
District Normal	16	15.41 "
Crop Season, Normal for Dis- trict, February to August.		11.81 "

II—EASTERN DISTRICT.

1. Cheyenne Wells	11	15.64 inches.
2. Fort Morgan	9	11.53 "
3. Fox	13	16.65 "
4. Grover	8	11.29 "
5. Holyoke	9	15.96 "
6. Le Roy	16	15.30 "
7. Wallet	10	18.11 "
8. Wray	12	17.30 "
9. Yuma	14	17.05 "
10. Selbert	10	15.21 "
District Normal	11	15.41 "
Crop Season, Normal for Dis- trict, February to August.		12.66 "

III—ARKANSAS-PLATTE DIVIDE.

1. Castle Rock	13	17.74 inches.
2. Colorado Springs	25	14.32 "
3. Glen Eyrie	13	15.35 "
4. Haups (Hugo P. O.)	12	13.76 "
5. Husted	17	15.98 "
District Normal	16	15.37 "
Crop Season Normal for Dis- trict, Feb. to August		12.56 "

IV—ARKANSAS VALLEY AND BACA CO.

1. Canon City	15	12.33 inches.
2. Holly	9	15.16 "
3. Lamar	14	15.57 "
4. Las Animas	37	11.33 "
5. Pueblo	17	12.11 "
6. Rocky Ford	15	12.86 "
7. Blaine	14	15.89 "
8. Villas	14	14.01 "
District Normal	17	13.53 "
Crop Season Normal for Dis- trict, Feb. to Aug.		10.67 "

THOROUGH TILLAGE SYSTEM FOR PLAINS OF COLORADO. 27

V—SOUTH CENTRAL DISTRICT.

	No. Years.	Average Annual. Precipitation Normal.
1. Hoehne	14	18.15 inches.
2. Trinidad	10	17.10 "
3. Westcliffe	11	17.41 "
District Normal	12	15.89 "
Crop Season Normal for Dis- trict, Feb. to Aug.....		11.24 "

VI—SAN LUIS VALLEY.

1. Garnett	12	6.38 inches
2. Saguache	14	7.22 "
3. San Luis	14	11.78 "
4. Fort Garland	25	12.74 "
District Normal	16	9.53 "
Crop Season Normal for Dis- trict, Feb. to Aug.....		6.81 "

VII—SOUTHWESTERN DISTRICT.

1. Durango	12	16.04 inches.
2. Mancos	6	13.72 "
3. Hermosa	7	14.30 "
District Normal	8	14.69 "
Crop Season Normal for Dis- trict, Feb. to Aug.....		8.58 "

VIII—GRAND AND UNCOMPAHGRE VALLEYS.

1. Cedaredge	12	10.93 inches.
2. Collbran	12	13.65 "
3. Delta	14	8.04 "
4. Fruita	6	8.77 "
5. Grand Junction	17	8.50 "
6. Grand Valley	13	11.20 "
7. Montrose	10	9.11 "
8. Paonia	10	9.62 "
9. Silt	10	12.04 "
District Normal	12	10.21 "
Crop Season Normal for Dis- trict, Feb. to Aug.....		7.89 "

IX—NORTHWESTERN DISTRICT.

1. Lay	12	12.13 inches.
2. Meeker	13	15.66 "
3. Pagoda	14	18.76 "
4. Rangeley	8	8.39 "
District Normal	12	13.74 "
Crop Season Normal for Dis- trict, Feb. to Aug.....		8.44 "

RAINFALL BY MONTHS AT THE AGRICULTURAL COLLEGE, FORT COLLINS, COLORADO.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
1872	0.25	0.16	0.00	1.20	2.30	1.50	1.30	0.83	0.75	0.42	0.02	0.20	9.10
1873	0.06	0.43	1.29	0.77	0.95	0.65	3.15	0.25	0.00	1.00	0.20	0.00	10.40
1879										1.75	0.15	0.60	
1880	0.72	1.19	0.35	0.94	0.60	0.86	1.80	0.37	1.47	2.07			
1881	1.10	0.55	1.45		4.67	2.07	1.76	0.89	2.51	6.82	0.29		
1882			0.17		2.51	3.18		1.78	1.00	1.29	T	1.23	
1883	1.00	1.50	0.68		4.84					0.10	1.30	0.35	
1884	1.10	0.70	1.15	3.94									
1885	1.77												
1886													
1887	0.86	0.23	0.25	1.10	1.23	1.96	3.05	2.12	0.54	0.69	1.18	0.33	12.12
1888	0.29	0.36	0.73	1.23	3.39	0.47	0.60	1.01	0.29	0.43	0.15	0.10	9.79
1889	0.21	0.34	0.65	2.07	3.99	2.06	0.79	0.95	0.43	0.88	0.38	0.16	14.49
1890	0.13	0.31	0.23	2.92	1.19	0.12	1.37	3.14	0.07	0.70	0.32	0.12	13.53
1891	2.32	0.16	1.21	2.14	4.07	1.30	0.17	2.05	1.01	0.30	0.80	0.46	15.69
1892	0.60	1.29	1.52	1.60	4.53	2.43	1.32	0.22	0.14	0.93	0.23	0.01	15.45
1893	0.08	0.54	0.14	1.66	1.92	0.26	0.64	0.93	0.18	0.16	0.55	0.12	7.11
1894	0.25	0.60	0.67	0.89	2.09	0.42	1.72	1.53	2.29	T	0.14	0.76	12.36
1895	0.24	1.52	0.54	1.36	2.63	3.65	3.75	1.45	0.47	1.06	0.40	0.01	13.07
1896	0.43	0.03	1.73	1.36	2.63	3.06	3.05	2.30	1.55	0.49	0.05	0.24	15.76
1897	0.13	0.54	2.15	1.39	2.06	1.69	2.65	1.74	0.75	0.75	0.67	0.67	15.24
1898	0.65	1.04	0.90	1.08	2.65	1.37	0.50	0.93	0.83	0.83	1.24	0.17	11.03
1899	0.66	1.12	1.10	1.01	1.01	1.03	4.95	0.99	0.21	3.23	T	0.47	16.19
1900	0.25	1.04	1.07	10.56	1.75	0.63	1.14	0.16	1.92	0.24	0.07	0.11	19.31
1901	0.38	0.38	1.86	3.63	7.47	2.35	0.71	0.72	2.10	0.36	0.03	1.37	21.17
1902	0.32	0.15	1.50	0.61	2.12	2.43	1.31	0.67	7.12	1.15	0.27	0.77	18.45
1903	0.16	1.60	1.03	1.50	0.63	2.23	1.06	0.23	0.87	1.12	0.13	0.07	11.31
1904	0.04	0.34	0.51	0.89	5.87	1.65	1.99	0.71	1.06	0.39	0.18	0.12	13.13
1905	0.39	0.35	1.75	6.32	4.12	0.64	2.18	1.25					
Average.....	0.52	0.61	0.95	2.22	2.93	1.64	1.73	1.13	1.18	0.95	0.36	0.35	14.75

It is to be observed that the weather station records have not been taken for the same length of time in the different districts nor for the same number of years at the various stations within the districts.

The above record is just as the U. S. Weather Office has received it and indicates the number of years the different stations have reported observations. It may possibly be interesting, in this connection, to look over the rainfall by months and years, as recorded by Mr. R. E. Trimble, in charge of the meteorological observations at the Fort Collins Station, in the North Central District of the state:

It will be seen by this table that the years 1873, 1888 and 1893 had less than 10 inches and the year 1901 more than 20 inches of rainfall. The last ten years show an average of 15.95 inches, while the preceding years, for which there is full record, give an average of but 12.12 inches rainfall. This would seem to suggest that our rainfall has great variations. It was the exceptionally dry years of 1873, 1888 and 1893 which gave the farmers on our eastern plains little or no harvest.

It is these "dry" years which test all systems of crop farming and soil culture. The past few years have been quite favorable for any system of careful farming, but we need to profit by the experiences of the past and not rely too much upon the average rainfall or even the rainfall for some several years back. It is those years with a minimum rainfall which test our systems of crop farming. We have not met these years very successfully in the past, and the careful plains' farmer will be conservative in his farming ventures, until he has successfully tided over one or more of the "dry" years, when the rainfall drops below 10 inches per annum.

Conclusions.

1. Do not assume that all unoccupied land is good farming land under any system of soil-culture or crop farming.

2. Character of soil, amount of rainfall, method of farming and market conditions, on land where irrigation can not be practiced, must largely determine the success or failure in all farming ventures in Colorado.

3. Methods of farming which (a) conserve the soil moisture, (b) prepare a good seed bed, (c) reduce the evaporation to as near the minimum as possible, (d) use good vital, acclimated seed, (e) employ a crop rotation which has stock foods prominent, contain at least one money crop, (f) and the practice of thorough tillage of the ground, often tide the farmer over bad years and insure his success in good years.

4. With all these conditions met, crop failures or low prices will prove disastrous some years, unless stock raising is combined with crop farming.

5. Most of the crop should be "driven to market," in the stock sold from the farm.

6. Natural conditions must be considered in determining whether lands can be made more profitable for farming than for grazing purposes.

7. The first principles of semi-arid farming was enunciated by the English farmer, Jethro Tull, nearly three centuries ago, who said "Tillage is manure."

8. Present day experiences and experiments demonstrate that tining the soil has a tendency to render more plant food available.

9. All so-called soil culture systems, are groupings of few or many of the principles of the thorough tillage system, which is the correlated experience of our best farmers of past and present time.

10. The Thorough Tillage System of farming considers:

(a). Time and manner of plowing the ground.

(b). Time and manner of harrowing.

(c). Firming the soil and formation of an earth mulch to arrest evaporation in semi-arid regions.

(d). Summer culture to fine the soil, conserve moisture and prepare a good seed bed for any crop under drouth conditions.

(e). Principle of capillarity and how moisture may be conserved.

(f). Selection of seed and rate of seeding.

(g). Crops which have shown drouth resistant power.

(h). Amount of moisture required by plants.

(i). Average crop season rainfall for a period of years in locality where farming is to be practiced.

(j). Crop rotations most profitable for the farmer and the land.

11. Small grain, forage crops and potatoes have been successfully grown on the Colorado Divide and in certain sections of eastern Colorado, without irrigation. Thorough tillage will undoubtedly increase the areas where these crops can be successfully grown in our semi-arid lands.

12. Our best native grass—Western Wheat Grass, (Colorado Blue Stem)—Prof. R. A. Oakley of the Agrostology Division of the Department of Agriculture, Washington, D. C., finds will do best on irrigated ground with one early irrigation. More water is a detriment. This would indicate we may yet be able to induce this grass to make a profitable hay crop on cultivated lands where we have ten or more inches of rainfall per annum.

13. Roots of all cultivated plants make their best growth when the following conditions are supplied:

A firm, mellow, A warm, mellow, A ventilated, A moist	}	soil well supplied with plant food.
--	---	-------------------------------------

14. The earth mulch prevents excessive evaporation and thus conserves moisture.

15. Deep plowing furnishes a soil reservoir of good depth to store moisture and summer culture conserves it.

16. Crops require more moisture to mature them under semi-arid than under humid conditions.

17. Our field crops rank from the lowest to highest in amount of moisture required to mature them as follows: Corn, potatoes, wheat, barley, field peas, oats, alfalfa and red clover.

18. Ten inches of rain furnishes enough moisture to mature more than twice that number of bushels of wheat per acre.

19. The amount of rainfall, together with the selection of drouth resistant crops, must be considered under any system of soil culture—under semi-arid conditions.

20. The total area of land which can be successfully farmed within Colorado's semi-arid belt is yet to be determined.

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A Rust-Resisting Cantaloupe

BY PHILO K. BLINN

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A Rust Resisting Cantaloupe.

PHILO K. BLINN.

The cantaloupe rust, or "blight" as it is called, has for a number of years inflicted serious injury to the cantaloupe industry in Colorado in the vicinity of Rocky Ford, and recently it is reported as being the cause of similar trouble in other cantaloupe growing sections of the United States.

The prevalence of the disease is largely affected by climatic conditions, yet in localities like Rocky Ford, where cantaloupes are continually grown, the soil becomes so infested with the spores that its development is as regular as the seasons, yet varying somewhat as to the loss it causes. In very dry seasons its development may not excite much notice, other than the dying down of some of the leaves in the centre of the hill, and perhaps a few yellow spots or specks on the leaves over the plant. On the other hand if the season is subject to rains and dews its development is very disastrous to the crop. Often before the plants reach maturity the disease so destroys the functions of the leaves that the cantaloupes prematurely ripen, and have no desirable qualities for table use and are a disappointment to everyone handling them. A few days of cloudy, wet weather will so precipitate the disease that the leaves and vines will go down as if swept by a blast from a furnace; the cantaloupes will become soft and wilted and if marketed will result in loss, though it sometimes happens that if rust strikes a field of cantaloupes at about the time the melons reach maturity it will so hasten the ripening that enormous yields are sometimes marketed in a very few days, when the prices are high, thus resulting in advantage to the grower. But invariably the same conditions which hasten the ripening of one field will also hasten others, and the shipments will increase beyond all proportion to the market demands, and at the same time the quality will decrease with equal rapidity and, before it is realized, the market is full of cantaloupes inferior in quality, and very disheartening returns are made.

The recurrence of these rust injuries seems to be more common with each succeeding season, and even the grower who by careful cultural methods or favored location escapes a serious attack, is still unable to get satisfactory returns, owing to the demoralized condition of the market due to melons from rusted areas. It seems evi-



Plate V. Two plants that grew in the same hill, one killed with rust, the other rust resisting.

dent that some effective remedy or means of control must be found to restore confidence in the melon crop.

The Cause of the Disease.—The cantaloupe rust or "Blight" so called, is the effect of a parasitic fungus which grows and develops on the tissues of the plant. It has been named "*Macrosporium Cucumerinum*," by Ellis and Everhart. It spreads and develops by means of spores that are carried by wind and other means and which develop when conditions are favorable. The idea that rain and dew cause the rust is true in the same sense that rain causes weeds,—it simply affords conditions favorable for development.

Investigations for Controlling the Disease.—In 1898, H. H. Griffin, of the Colorado Experiment Station, began investigations to control the disease. He carefully conducted field tests with sprays of different fungicides, and Bordeaux mixture gave promise of encouraging results, but owing to the rapid growing nature of the cantaloupe vines, and the frequency of spraying required, with its attendant expense, this plan proved impracticable.

By a series of tests, it became evident that the disease is not communicated by the seed, except as it might occasionally occur from spores accidentally lodging with the seed.

The next step was the development of a resistant strain of cantaloupes.

A Rust-resisting Cantaloupe.—In the summer of 1903 a close study of the cantaloupe fields was made to ascertain if any variation existed in the rust resisting tendency of the various strains of Rocky Ford cantaloupe. Owing to the different soil conditions and cultural methods on different farms, and the varying ages of the vines, conclusions were difficult to draw, as all the vines seemed to be affected with rust to some extent, and eventually all succumbed to its attacks, though several growers claimed to have cantaloupes that did not rust "like their neighbors."

In order to make a relative comparison of the point in question a small quantity of seed of five of the oldest and most distinct strains of seed, was secured from those who were propagating them. This seed was planted on a plat of ground that in 1903 had grown a very badly rusted crop of cantaloupes; two rows of each kind were planted May 9th, 1904, with a row of watermelons separating each variety to prevent their vines from intermingling. The whole plat had uniform conditions of culture in every particular and the vines of each variety made a very similar growth. About Aug. 1st the rust began to develop in the center of the hills, and it soon became evident that the disease was not making the same progress on all plants. Some of the hills in the rows planted with seed furnished by Mr. J. P. Pollock remained green throughout the season,



Plate I. Cantaloupe hill dead with rust.



Plate II. Cantaloupe hill resisting rust. Both views taken Sept. 24, 1904, on adjacent hills—J. H. Whittenburg farm.

and also produced the first ripe cantaloupe from the plat, Aug. 9th. A few days later the other strains gave a greater yield of early melons, doubtless due to the rust, which soon after destroyed all the plat except the hills mentioned.

These observations were verified in other fields planted with the Pollock strain. That of W. B. Ebberts, east of Rocky Ford, was an exceptionally fine field of cantaloupes, and revealed green hills here and there over the patch after all neighboring fields had been destroyed by rust. A portion of the cantaloupe field on Mr. J. H. Whittenburg's place, west of Rocky Ford, was planted with the Pollock seed and the balance with what is known as the "Blinn" strain. By Sept. 24th the portion of the field planted with the Pollock seed had many hills that remained green, when the balance of the field was brown and dead with rust.

Plates I and II fairly represent the contrast in the two portions of the field. These give views of adjacent hills. Plate II is a resistant plant, grown from the Pollock seed; Plate I a rusted hill from the other strain. There was also a remarkable contrast in the superior quality of the cantaloupes produced from the resistant hills; these were uniformly sweet and spicy and possessed excellent keeping qualities.

A quantity of seed from the rust resisting hills was selected to carry on the work of developing a rust resisting strain of cantaloupes.

During the past season, 1905, this resistant seed was planted on the same plat of ground upon which the experiments had been previously conducted, and which had grown in succession two very badly rusted melon crops, the idea being to develop the resistant strain in as adverse rust infested conditions as possible, to thus reveal the most strongly resistant plants.

The results of the past season were affected somewhat by the destructive hail of May 26th, yet fortunately by replanting, and with some hills which survived the hail, very encouraging results were obtained. Many who visited the plat were surprised at the great contrast between the rust resisting hills and those from ordinary seed.

Plates III and IV, views taken Sept. 20th, reveal the contrast not only in the vines, but also in the character of the melons produced on the respective hills. On the rust resisting hills the melons were hidden under a healthy growth of vines and were large, solidly netted, with thick, firm flesh, small seed cavity completely filled with seed. On the rusted hill the plants were almost devoid of leaves and the small melons were prematurely ripe, with thin, watery flesh, large, open seed cavity, and practically of no market value.

Plate V shows the contrast between two plants which grew in the same hill; one, entirely dead from rust, the other absolutely free from the disease—this view taken Oct. 1st. This hill was grown from a general selection of Pollock seed and reveals the necessity of individual plant selection to eliminate the reverting tendency of some plants.

Hills grown from the seed of one resistant cantaloupe produced nearly all resistant plants,—the whole row showing green except an occasional vine attacked by rust.



Plate III. Rusted hill, showing poor, undeveloped melons, taken Sept. 20, 1905

Field observations were again made to verify the existence of resistant plants in fields planted with Pollock seed, and in every instance the green resistant plants could be seen remaining over the field after the balance of the vines were dead with rust.

During the shipping season, before the vines had gone down with rust to any extent, several conspicuously resistant plants in the fields of Messrs. C. J. Cover, J. B. Ryan and I. D. Hale, were observed and marked for seed.

Each grower has reported that these hills remained green till frost.

The relative merits of the Pollock melon, and the interest created by the investigation of its rust resisting tendencies led many growers to plant it this past season, and many other growers are anxious for any evidence toward the improvement of the cantaloupe industry.

The fact that during the past two seasons, several names have been given to the Pollock cantaloupe, such as "Eden Gem," "Netted Rocks," and other suggestive titles, also that several Associ-



Plate IV. Rust Resistant Hill, showing fine qualities of netting and thick flesh, taken Sept. 20, 1905.

stions and commission men are insisting that their growers shall plant only this strain, seems to be good evidence of its practical merits.

In the light of investigation, the rust resisting tendencies of the Pollock strain, seem to offer the most immediate solution of the rust problem. With this object in view, we hope to induce the cantaloupe growers to consider rust and disease resisting plants as

an important feature in seed selection and lead them to furnish information that will assist in securing that end.

As a matter of information regarding this strain of cantaloupes, an inquiry was directed to Mr. J. P. Pollock asking for a short history of the cantaloupe while it was in his hands. The following is his reply:—

1908 Colorado Avenue, Colorado Springs, Oct. 6th, 1905.

Mr. P. K. Blinn,

Dear Sir:—

Yours at hand; I note what you say regarding the Pollock cantaloupe with pleasure, mainly because if you are correct in your conclusions as to its rust resisting qualities, I have been instrumental in doing good to the community.

Now as to its history; I began growing the strain nine years ago in Holbrook, my first experience in melon culture and farming in Colorado.

I got two lots of seed from Ellingwood and Houck, one at 50 cts. per lb. and the other at \$3.00 per lb.; the 50c seed grew large melons, too large, not one tenth being of a size to crate. The \$3.00 seed produced good cantaloupes, most of them good sized and very heavy netted, not a short melon but correct in length; I saved my seed selecting the proper size and netting,—you may draw your own conclusions as to whether there was cross fertilization producing the origin of my future strain.

The next year I planted at Rocky Ford; I had a fine growth of vines and setting of cantaloupes, I distinctly remember the heavy growth of vines. It was my first experience with plenty of water, and I overwatered and the rust struck the patch, and I had quite a failure; the whole patch was ruined and I was soon counted out at the platform on the score of rusted vines. However, I selected my seed from the patch, selecting a large sized melon with a white close netting, and a perfect cantaloupe as I remember it, in the midst of the rusted vines; I never had much trouble with rust after that, and in the light of your conclusions as to its rust resisting tendencies, I now believe, I unwittingly selected a rust resisting melon, as the rest of my crop were slick melons that failed to mature. Thereafter I always had my eye on that same type of melon in selecting my seed; it was a full large sized melon, with netting over the blossom end; not a long melon, but rather inclined to be short, but it had the qualities. By selection I reduced the size of my cantaloupes down till the last two years that I grew them they averaged well to crate nicely. I often thought of changing my stock of seed, but after going through the season, having very little trouble with culls or inferior melons and the quality seeming to me superior in comparison with anything I could get hold of, I stayed with it. I could easily see that they had peculiarities of their own compared with other cantaloupes.

Now if the using of my name in this connection meets with your approval, it is certainly satisfactory to me, and I will feel honored. Wishing you success in the work and asking for a copy of your Bulletin, I am,

Yours truly.

J. P. POLLOCK.

This bit of history reveals why this strain of seed shows resistant tendency; it has a line of selection to that end, though unintentional at the time. There is an old law in nature called the "Survival of the fittest," it applies to plants as well as animals; it simply means that in nature individuals that are able to grow and develop in the midst of adverse conditions are thus naturally selected to resist the attacks of their enemies. It is for this reason

that our native plants and weeds are so little affected by adverse conditions, while our cultivated crops are so susceptible. For many generations under cultivation, they have been developed for certain purposes, and the vital line of selection has been neglected. This is especially true in regard to some cultivated flowering plants; their existence depends entirely upon the care and protection of man. If they were left to their natural enemies, they would soon become extinct.

No work in connection with agriculture is so important in its results as that of *seed selection*. Too long it has been merely *seed*



Plate VI. Single plant that produced sixteen large cantaloupes.

saving, and if selection has been considered it has been along narrow lines, perhaps size, form or appearance has been considered at the expense of quality, or possibly it has been the quality at the expense of vitality.

A standard of perfection covering all the essential points in the development of a perfect cantaloupe would assist the grower in keeping his selection so balanced as to strengthen or build up any weakness, his strain of seed might reveal. To this end the following points might be considered as a schedule for selection.

SCHEDULE FOR SEED SELECTION.

P-rolific yielding,
E-arly maturing,
R-esisting tendency,
F-orm, size and netting,—ideal,
E-picurean qualities, sweet and spicy,
C-avity, small, well filled,
T-exture, smooth and firm.

While the field is growing, select and mark any individual plants that show exceptional merit along the lines of prolific yield, early maturity or resistant power. That such variation frequently occurs is plainly shown by the field observations of the past three years; many plants were observed which produced only three or four cantaloupes during the entire season, while in one instance, shown in Plate VI, sixteen large cantaloupes were produced from one plant, which would be a very large yield for three or four ordinary plants. The variation in maturing was revealed in the comparative test of the five strains of seed before mentioned. Ten days elapsed between the first ripe melon on one strain, and the first of another, although the rows were given uniform conditions.

The variation in resistant power has already been indicated.

One very important feature of the work of seed selection is the marking of individual plants which show desirable qualities. The seed should be saved separately, labeled and grown by itself, thus fixing in the strain these desirable traits.

In the past the seed saving has been too much from a general selection of the melons without regard to the merits of the vines from which they grew; and also a common error has been in giving too much attention to the external points of the melon without considering its internal qualities. This is well illustrated in Plates VII and VIII which show a choice pile of cantaloupes selected for outside appearance only; the other view shows some of the same melons cut in half revealing the undesirable large open cavity and thin flesh of some, and the solid, well filled cavity and thick flesh of others.

When the marked hills reach maturity the vines which reveal the most uniform sized cantaloupes of ideal form and netting should be taken as the basis for selection. That the size as well as other qualities is affected by seed selection is brought out in the letter of Mr. J. P. Pollock, in which he states that he "reduced the size down until they averaged well to crate."

There are many conditions which may affect size and to some extent each grower should study his soil from the standpoint of the melons which it produces, and govern his selection accordingly.

The netting of a cantaloupe has long been considered an attractive fancy feature and without question it is the essence of its



Plate VII. Pile of cantaloupes selected from outward appearance only.



Plate VIII. Some of the same cantaloupes showing contrast of internal qualities.

appearance on the market, and experience reveals that it has a value in protecting the keeping qualities of the melons on long shipments.

The words "Rocky Ford" scratched on the surface of a green melon appeared in the netting at maturity, thus showing that the netting of a cantaloupe is merely a tracery of callous formed by the natural cracking of the surface of the melon.

By observation and tests it is shown that a close netted melon does not lose weight by evaporation as rapidly as one less covered with netting, thus its keeping and shipping qualities are largely determined by the amount of netting on its surface.

Plate IX represents a former ideal Rocky Ford Netted Gem, a melon characterized by a close heavy netting divided by clear cut sectors. But the tendency of these stripes is to widen under careless selection, and in view of the superior keeping qualities of the "solid net," the old ideal is giving way to a type represented in Plate X which is a result of a cross of the Pollock strain and the melon shown in Plate IX, known as the "Blinn" strain. The form is more nearly perfect to fit the standard crates than the round type characterizing the Pollock strain, and its internal qualities are in keeping with the external appearance.

The eating qualities of a cantaloupe are the ultimate test of its perfection. A cantaloupe produced from a strong healthy vine and yet not having a sweet spicy flavor, should never be saved for seed.

The small cavity, solidly filled with seed, a thick flesh with smooth, firm texture, are obvious points in the value of a marketable cantaloupe. These with many minor points should be zealously guarded by the careful seed selector.

There is no absolute, fixed relation existing between the points of the above schedule. Thus, the selection of melons for resistant power only, will not insure netting or other qualities. On the other hand, an ideally perfect melon, if unable to resist rust, would be a failure; but careful attention to all these details in due proportion, will result in a melon like that shown in Plate X,—a cantaloupe having a "money basis."

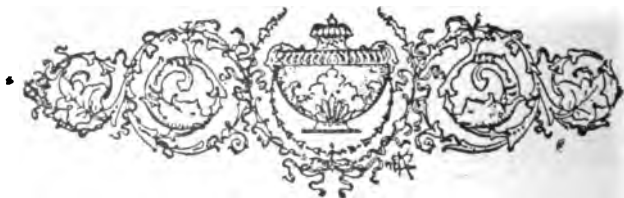




Plate IX. An old ideal of perfection. From Bulletin 85, 1903.



Plate X. A perfect Pollock cantaloupe, selected for resistant tendency. "A cantaloupe with a money basis."

Bulletin 105.

November, 1905.

The Agricultural Experiment Station
OF THE
Colorado Agricultural College.

A New Apple Rot.

BY B. O. LONGYEAR.

PUBLISHED BY THE EXPERIMENT STATION
FORT COLLINS, COLORADO
1905

The Agricultural Experiment Station,

FORT COLLINS, COLORADO.

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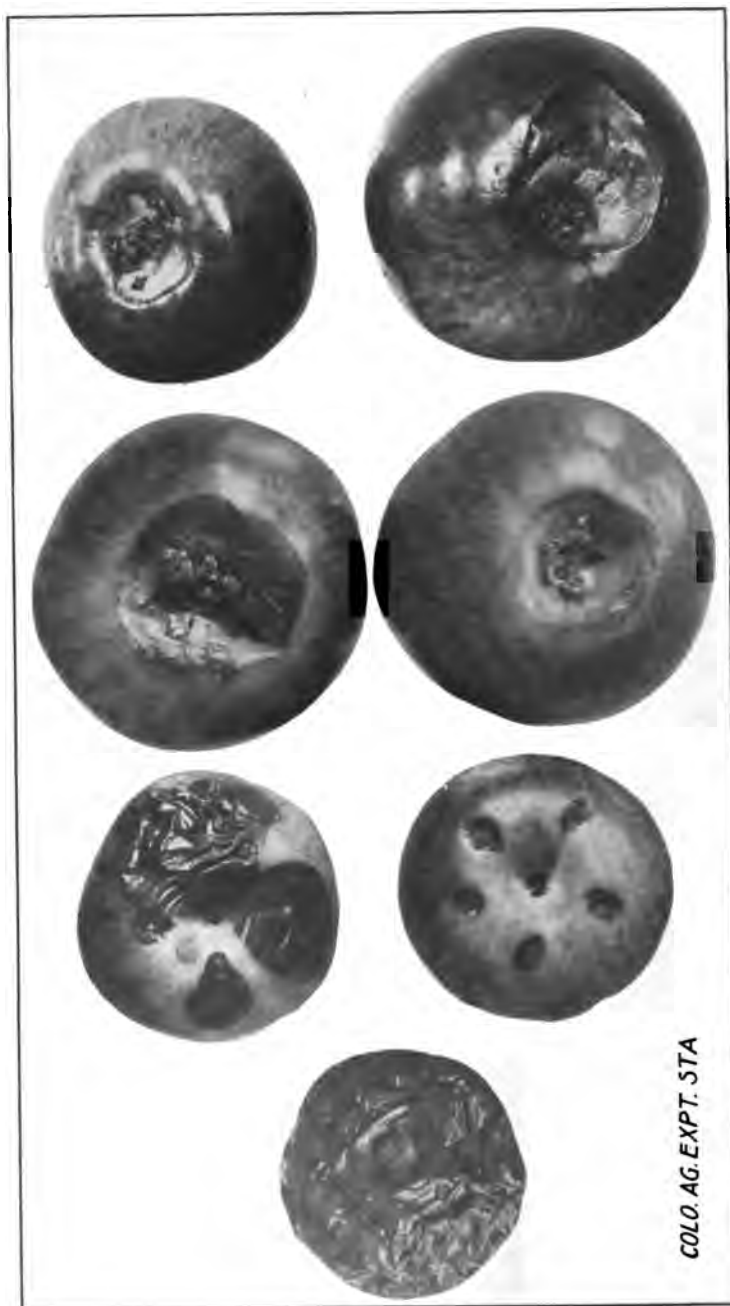


PLATE I.—Four Ben Davis apples showing the *Alternaria* Rot in the blossom end (on the right).
Three apples artificially inoculated with spores of the *Alternaria* (on the left).

An Apple Rot Due to An Undescribed Species of *Alternaria*.

BY B. O. LONGYEAR.

HISTORY AND DISTRIBUTION.

Among the comparatively few diseases of orchard fruits, which occur in the state of Colorado, probably the most widely distributed and common one is a decay of apples and pears due to an apparently undescribed species of *Alternaria*. This decay was first met with by the writer at the Michigan Agricultural Experiment Station in the winter of 1904. While investigating the decays of stored apples at that place, a single specimen was found showing a decay of unfamiliar appearance. A tube culture was made from spores obtained by placing this specimen in a moist chamber for several days, and inoculations of sound fruit were made which demonstrated the ability of the fungus to induce the decay.

At this Station the fungus was first reported in November, 1902, and specimens were secured for study by Professor W. Pad-dock, who recognized the fungus as being a species of *Alternaria*. He also conducted some inoculation experiments with the fungus and made the first report of it in the Experiment Station report of 1904. Investigation shows it to be of quite common occurrence in this State and it has been also found in the core cavity of one variety of apples grown in California.

Thus, while this decay evidently occurs over a wide range, the fact that it has thus far been unnoticed, indicates that it is probably not destructive to any extent in other regions.

CHARACTER OF THE DISEASE ON THE APPLE.

In the case of the apple, so far as studied, the fungus is confined to the fruit, its most common point of attack being at the blossom end. The affected fruits usually show a dark purplish brown, slightly sunken area at the base of the sepals. This area may remain small and scarcely noticeable for a long time, but when the fruit is placed in storage it is apt to increase in extent until the fruit is entirely decayed. During the past season specimens were found in which the blossom end of the apple was cracked open and a considerable area of the discolored tissue surrounded the rupture, but this is not the usual manner of attack. It seems probable in



PLATE II.—Keiffer pears showing spotting and cracking due to the *Alternaria*.
Picked from the trees in September.

these cases that the fungus was not the cause of the cracking, but merely gained a foothold in the wound. Other wounds in the fruit, such as those caused by the larvæ of the codling moth, are frequently the point of attack of this fungus.

The rotting due to this fungus is usually not so rapid as that caused by some of the soft rot fungi. Hence, fruit that is already affected by the *Alternaria* in some cases succumbs to some of the more rapidly working rots which not infrequently seem to follow it. The affected tissue is not greatly softened by this fungus, but by drying out finally changes to a shrivelled dark brown mass similar to that produced by the mummifying effects of the brown rot of stone fruits.

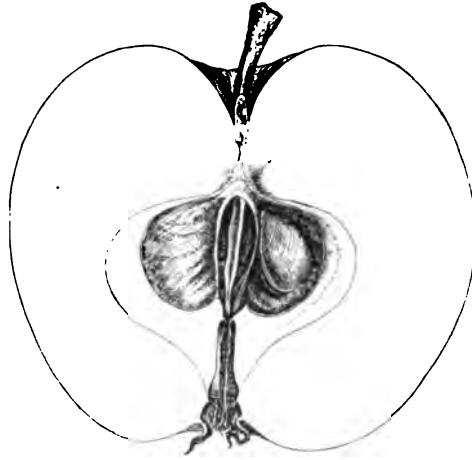
In many cases, however, no external evidence of the presence of the fungus is noticeable until the apple is cut through when the core cavity is found to be blackened or discolored. In the majority of such cases the parchment-like lining of the seed cavity is the only part showing the discoloration which, in mild cases, appears in the form of brownish or blackish streaks or stains. The seeds, too, are usually coated with a dark colored growth of the mycelium. In badly affected specimens, however, the seed cavity is nearly filled with fungous threads, while the discoloration extends into the surrounding flesh of the fruit to a greater or less extent.

This invasion of the core by the fungus appears to be most common in certain varieties of the apple, among which the Wine Sap is especially subject to this form of attack. And in the worst cases this variety shows some evidence of the presence of the blackened core by a slightly contracted appearance and yellowed color of the blossom end. Fruit which is of good size and normal depth of color seems usually to indicate freedom from this condition of the core, while fruit of small size with unusually light or dark color is frequently found to be affected.

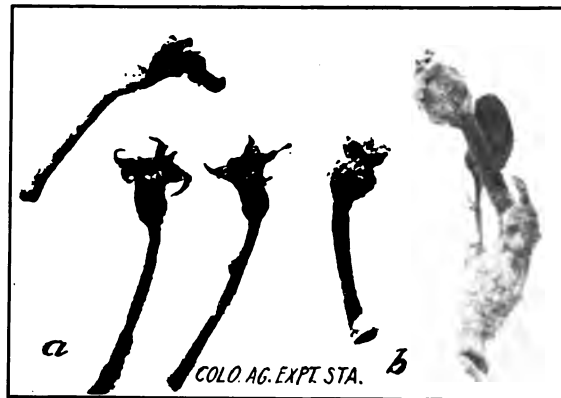
The reason why certain varieties of the apple are particularly subject to the blackened seed cavity is found in a structural peculiarity of such varieties. Thus a longitudinal section through such an apple usually shows a very deep calyx tube, which, in many cases, extends to or meets the core, or even opens into it. In such cases the fungus has evidently reached the core through this passageway by following the united styles and the inner wall of the calyx tube. (See Plate I and III).

ON THE PEAR.

In the case of the pear, the fungus has been found on fruit, leaves, and young sprouts at base of the tree. The fruit seems liable to attack at almost any point, in observed cases the stems being frequently blackened and the surface spotted irregularly. In the



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COLQ. AG. EXPT. STA.



COLQ. AG. EXPT. STA.

PLATE III.—Vertical section through a Winesap apple showing the very deep calyx tube meeting the seed cavity, which is darkened by the fungus (upper figure).
 (a) Young apples, fallen from the tree, showing the *Alternaria* after being kept in moist chamber. (b) Young apples and a fruit spur blackened with the fungus, after remaining on the tree over winter.
 Leaf of Keiffer pear affected with the *Alternaria* (lower figure).

latter case, too, the skin of the fruit is often cracked in the affected areas apparently from loss of moisture.

On the leaves of the pear the fungus produces brown spots of considerable size which are often situated along the margin or scattered over the surface in an irregular manner. (See Plate II and III).

MICROSCOPIC CHARACTERS.

The rotting effects of this fungus are due to the invasion of the tissues of the plant by numerous branching threads or hyphæ of mycelium. Thus a microscopic examination of the decayed part of an apple or pear reveals the presence of this mycelium in the form of an intricate network. These hyphæ vary considerably in diameter in some cases being so slender as to be seen with difficulty under even a high power. In numerous instances, the mycelium may be found in the cell cavity, in which case the slender hyphæ are often coiled to some extent. Within the affected tissues the mycelium is nearly hyaline, or but slightly yellowish in color and contains numerous minute oil drops; but as the fruiting or spore-bearing portions of the mycelium are reached, the hyphæ assume a brownish color. The conidiophores, or spore-bearing branches, possess rather thicker walls than the feeding part of the mycelium and are freely septate near the terminus.

The spores, conidia, are characteristic of those of the genus *Alternaria*. When seen in mass they appear blackish olive, but are of a brownish color when seen under the microscope. They differ much in size and shape, as well as in the number of cells composing them, varying from one cell in the smallest to ten or twelve cells in the largest. They are produced in simple or slightly branched chains with a narrowed portion, consisting of one or more lengthened cells, joining the spores. Thus, when the larger spores are separated they usually possess a somewhat flask-shaped form, the larger end representing the base or point nearest the conidiophore.

Spores may often be found by examining the calyx end of affected specimens of fruit, but are obtained most readily by placing such fruit in a moist chamber for a few days.

The spores germinate readily in water, each cell being capable of sending out a germ tube, and even portions of the conidiophores frequently act in the same manner. While the spores are capable of germinating as soon as mature, if conditions of moisture and temperature are not favorable they will remain dormant during the remainder of the season or until the conditions are suitable for growth. (Plate IV).

TIME AND MANNER OF INFECTION.

While the matter of infection has not been investigated to any great extent, it appears from observations made, in

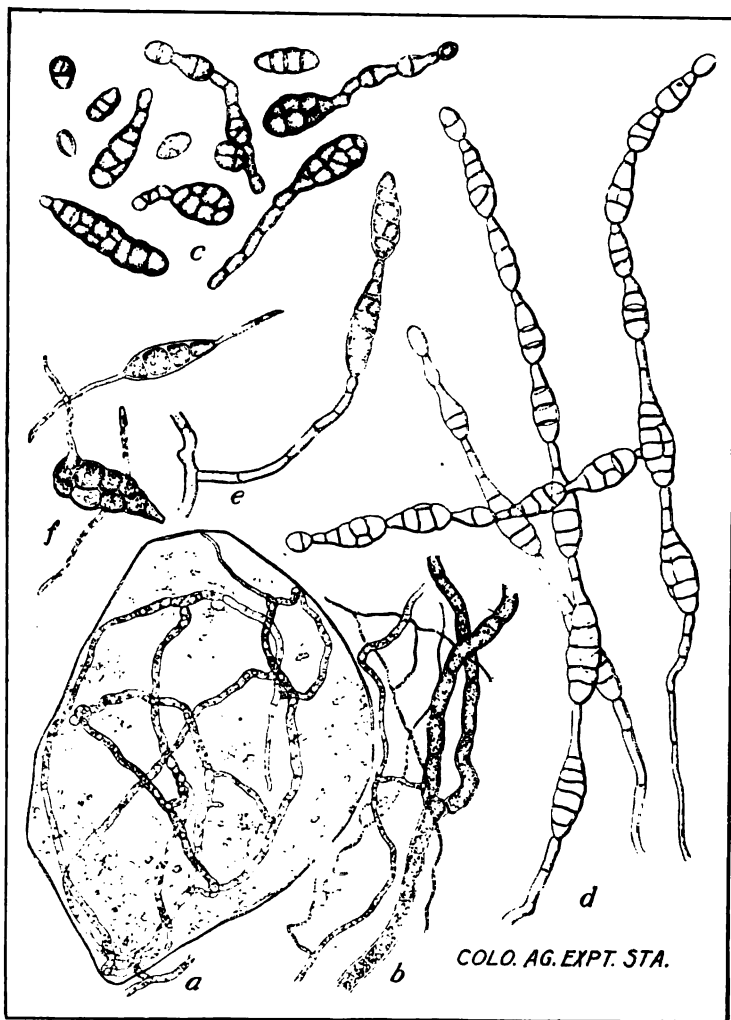


PLATE IV.—Microscopic characters of the *Alternaria*; (a) mycelial threads within a cell from rotting pear; (b) hyphae showing the variable size of the mycelium; (c) mature spores from a culture; (d, e) manner of spore-formation from culture; (f) two spores germinating in water, at the end of three hours.

the case of the apple, that the fungus gains a foothold on the withered stamens and stigmas which remain in the blossom end of the fruit. This may quite often occur early in the season soon after the flowering period and while the fruit is just forming. For, when the withered stamens and stigmas are placed in a moist chamber, at this time, the *Alternaria* frequently develops. The rotting effects of the disease, however, do not usually appear until after the growing period is nearly past and when the ripening stage is reached. Thus it would appear that the fungus is not capable of making much headway while the tissues are in a young, growing condition and when the vital processes are most active, but behaves more in the nature of a ripe rot fungus and is, therefore, not strictly parasitic. This is also suggested from the fact that young growing apples when inoculated with the fungus were not much affected by it.

The principal source of infection in spring appears to be the diseased fruits of last year, which remain in the orchard in a shrivelled and blackened condition, either lying on the ground, or sometimes left clinging to the fruit spurs. Young fruit which has failed to develop fully, perhaps due to imperfect pollination, is frequently found to be permeated with this fungus, after having withered upon the tree. In such cases the fungous threads within the tissues of these mummified fruits are capable of producing a crop of spores when the conditions are favorable the following spring. Some of these old diseased parts, when placed in a moist chamber, gave rise to a vigorous growth of conidia-bearing threads, the spores of which started the rot when used in making inoculations. The fungus evidently hibernates also on the twigs and fruit spurs, as it was obtained from them during the winter season. Wounds in the fruit caused by the larvæ of the codling moth frequently give entrance to the *Alternaria*. (Plate III).

ARTIFICIAL CULTURES AND INOCULATIONS.

Numerous cultures of the fungus have been made in the laboratory, using several different culture media. From these, inoculations of sound, ripe fruit were performed by inserting the spores of the fungus into punctures made with a sterilized needle. Usually in two or three days the point inoculated begins to show a surrounding area of decaying tissue, which widens rather slowly but steadily until the entire fruit is involved. The only fruit besides the pear and apple that has been inoculated with this fungus is the tomato, but in such cases it made almost no progress. (Plate I):

VARIETIES AFFECTED AND EXTENT OF INJURY.

In the case of the apple the varieties reported as most commonly subject to the *Alternaria* rot are the Lawver, Loy, Männ,

Dominie, Jonathan and Ben Davis, while the Winesap appears to be most commonly affected in the seed cavity, as previously mentioned. Some of these varieties are among those which are reported as dropping their fruit badly in some seasons during June and July, but whether or no the fungus plays any part in this matter has not been determined.

Among pears, the Keiffer is the only variety which has thus far shown any liability to attack from this fungus, although in the cases observed other varieties were growing in the same orchard.

The extent of the injuries due to this *Alternaria* have not been estimated even approximately. It is apparently, however, not a destructive fungous disease, as compared with some which attack the apple and pear in more humid regions. It is doubtless capable of doing considerable damage, however, to the fruit of susceptible varieties, some of which have been reported as almost failing to bring their fruit to maturity.

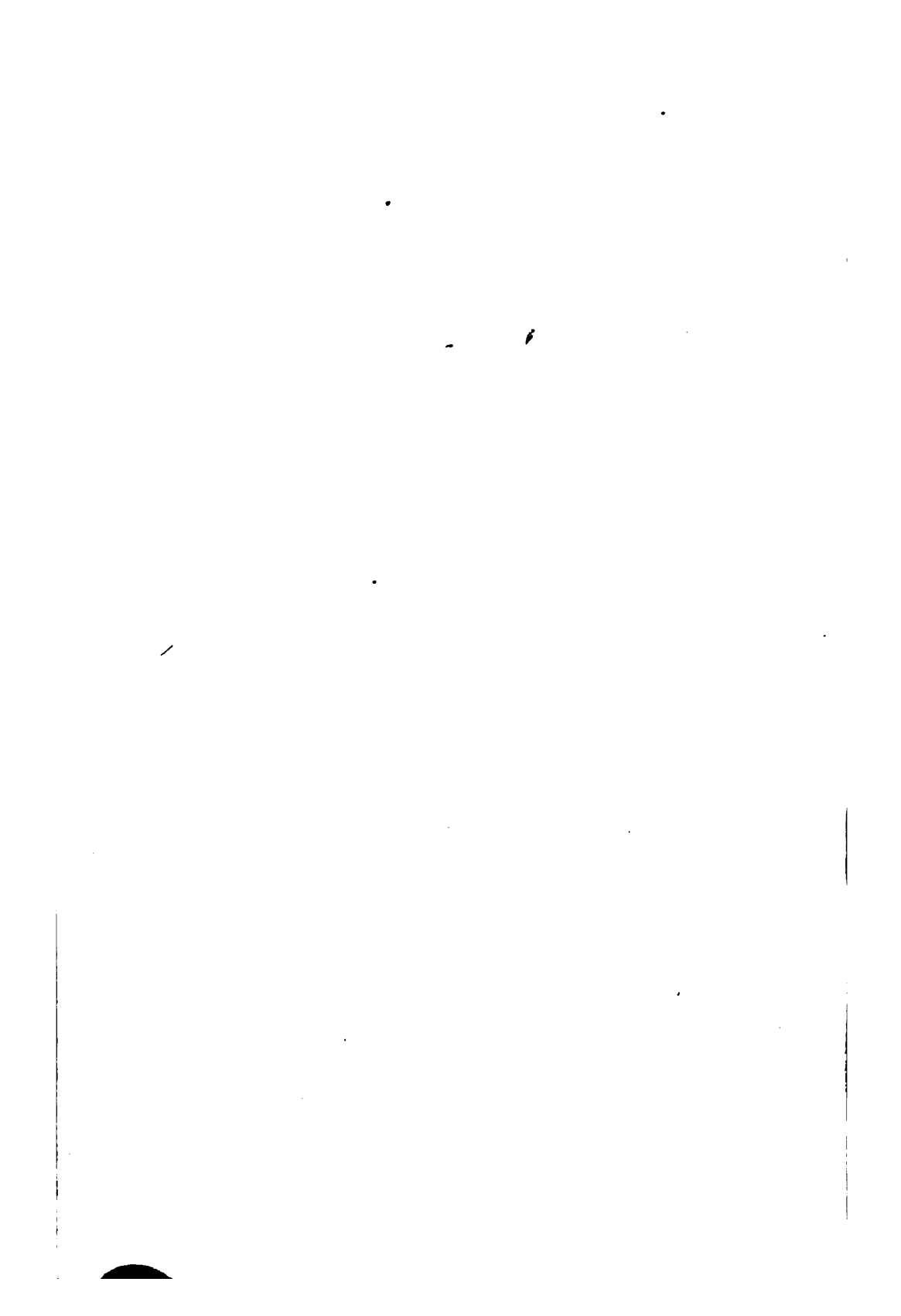
CONTROLLING THE DISEASE.

In the absence of any experimental work in the control of the *Alternaria* rot the methods for combating the fungus are necessarily suggestive. Attempts to control the fungus in one orchard, by the use of Bordeaux mixture, indicate that it can be much reduced. Whenever this fungus becomes troublesome the following measures are suggested:

(a) Clean culture, thereby covering up in spring all diseased fruit that is left on the ground under the trees besides keeping the trees in a state of good health.

(b) The use of some fungicide as a spray, the first application being a strong copper sulphate solution, one pound to twenty-five gallons of water, applied just before the buds open in spring. The standard Bordeaux mixture should be used after blossoming, making one or more applications during the growing season as may appear necessary. This may be used in conjunction with the poison mixtures applied for the control of the codling moth, thus saving extra labor and time.

(c) While it is very improbable that the disease will ever prove uncontrollable by the preceding means, should that occur, it would be advisable to discontinue the growing of varieties, which are particularly susceptible to the attacks of this fungus.



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December, 1905

The Agricultural Experiment Station

OF THE

Colorado Agricultural College.

PRUNING FRUIT TREES

BY WENDELL PADDOCK

**PUBLISHED BY THE EXPERIMENT STATION
FORT COLLINS, COLORADO,
1905.**

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Pruning Fruit Trees.

By Wendell Paddock.

HANDLING YOUNG TREES:—The writer has been impressed, when visiting the various fruit districts of the state, by the lack of knowledge on the part of many growers of the requirements of young trees. No doubt a large majority of our fruit growers come to the state with no experience in the business and so have everything to learn, and surely no part of orchard management is more important than to start the young trees just right. On this depends not only the future usefulness of the orchard but in many instances large numbers of young trees fail to live through the first season for the simple reason that the trees were not properly started. In several instances the Experiment Station has been asked to investigate the cause of the dying of newly planted trees, and on visiting the orchard it was found that the trees were planted just as they had been received from the nursery. No doubt some of them had been injured somewhat by exposure and improper care but with the best of treatment it is difficult for the mutilated root system of a transplanted tree to establish itself and at the same time support a vigorous or overgrown top.

It is not generally realized that when a tree is taken from the nursery row, a large portion of the root system is left in the ground. The balance between the roots and the top is thus destroyed and obviously a part of the top should be removed. Practically all of the elements which nourish and build up a tree, save one, are taken from the soil by the roots in liquid form. This material is carried in the cell sap mostly through the outer sap wood to the leaves. Here the crude food is changed by the influence of the sun light and the green substance of the leaves to a form that can be readily assimilated by the plant. This will illustrate, briefly, how important the roots are to a plant. Much of this elaborated food may be stored in the cells, especially in the fall, to be drawn upon at any time that the roots fail to supply the requisite amount. In transplanting, the nursery tree is often deprived of one-half or more of its roots, and not only must it become established in the soil but it must produce a large number of new roots before much new food can be supplied. In the meantime the leaves begin to push out

and the reserve food and moisture may all be used before the root system is in a condition to supply more.

Is it any wonder, then, that the failure to cut back the tops of newly planted trees results in the death of many of them? This is especially true in Colorado as the dry air and intense sunshine cause the young trees to dry out rapidly.

It is also true that many nurserymen, as well as fruit growers, are careless in handling trees before they are planted. Not infrequently the roots are exposed for hours to the drying action of wind and sun. One must take the chances of such treatment from the nurserymen but after the trees have been received by the grower there is no excuse for neglect in this respect. The trees should be heeled in deeply at once in damp soil and when planting the work should be so arranged that the roots of each tree shall be exposed to the air for the shortest possible time.

All bruised and torn roots should be carefully removed, leaving smoothly cut ends which will readily heal; if this is not done decay is apt to set in which may seriously injure the tree. Long straggling roots may well be shortened and if a tangled mass of fine roots are present they should be shortened and thinned. Some successful growers also insist that where large spreading roots occur a slanting cut should be made so that the cut surface may rest flat upon the ground.

It would seem to be almost superfluous to insist on the importance of having all nursery stock inspected by the County Inspectors, yet there are a few who try each year to evade the law in this respect. There are several insect pests and plant diseases, which are very common on young trees, all of which may be easily overlooked by anyone who is not thoroughly familiar with them. The wooly aphis is such an insect and it is doing a great amount of damage in all sections of the state. This insect lives on the roots of trees and is introduced to our orchards almost wholly by infected nursery stock. When once established it spreads rapidly and is almost impossible to eradicate. Crown gall is a common disease in many nurseries and it attacks all kinds of fruit trees. It is the worst kind of folly to plant a tree which has a trace of this disease, for not only is the tree pretty sure to die before it comes into full bearing but the infection may be spread by the cultivator or in the irrigation water to all parts of the orchard. A statement made in a former bulletin on the subject of inspection will bear repetition here:

"All possible assistance should be given the County Inspectors in their inspection of nursery stock. In counties where many trees are being planted, sufficient assistance should be provided, so that there will be no possibility of any shipments being overlooked. And finally some means should be devised whereby the importance of inspection can be impressed on the growers since, in some instances, they antagonize the in-

spectors and hinder their work. It is no doubt true, that the inspection of nursery stock alone, if well done, pays many times over for all the expense incurred, even in those counties which expend the most money in orchard inspection."

But in those counties where several hundred thousand trees are planted each spring the inspectors are so rushed with their work that the most careful men are liable to overlook an occasional infected tree; therefore no grower can afford to be unfamiliar with these common pests. Each tree should be reinspected as it is planted and to make the work thorough, the roots should be dipped in water so as to remove any dirt which might conceal small galls or a few aphids.

In this discussion it is presumed that the planting is done in the spring as this is nearly the universal practice in this state.

It should also be stated here that the requirements of apple trees have been foremost in mind in the following pages. The same principles will apply, however, to all of our other kinds of fruit with the possible exception of the peach. A short discussion of the special requirements of this fruit is given at the end of the bulletin.

The proper formation of the top is by no means the least important reason for cutting back the branches of newly planted trees. In the first place the importance of low headed trees for this climate cannot be too strongly emphasized. Hundreds of trees are dying in all parts of Colorado because of the exposure of the long trunks to the afternoon sun, either directly or by reflection from hot dry soil in summer or snow in winter. Young trees are especially liable to injury which results in early death or a weak, sickly growth from which they never recover. There is less injury from sun scald in the humid states, but in these districts many authorities are advocating lower headed trees.

In addition to forming low heads there can be no question but that it pays to still further protect the trunks of newly planted trees from injury by sun scald. Various devices are used, such as wrapping the trunks with burlap, paper, straw, wood veneer, or by shading the trunk on the southwest side with a thin piece of board set upright in the ground. Whitewashing the young trunks to serve the same purpose has come to be extensively used in portions of California. Whatever method is adopted, it should be applied soon after the trees are planted and kept in good condition through the second winter or until the shade of the trees becomes ample.

The advantages of low headed trees may be mentioned as follows: Greater ease in picking, thinning, pruning and spraying and less damage to trees and fruit from winds. Some growers object to low headed trees on account of the greater difficulty of cultivating around them, but with proper pruning low headed trees develop ascending branches as shown in plate I. There is not the slightest

difficulty in working around the trees in this orchard, whereas the branches on high headed trees commonly droop after they have borne a full crop of fruit and so interfere with all orchard management.

The following extract is taken from Prof. Bailey's Pruning Book:

"The relative merits of high or low heads for fruit trees are always in dispute. This controversy is partly the result of confusion of ideas, and partly of differing mental ideals and of varying climates. Two factors are chiefly concerned in these disputes—the question of ease of cultivation, and the question of injury to the trunk by sun-scald. It is the commonest notion that short trunks necessarily make low heads, and yet any one who can see a tree should know better. The number of trunks which a tree has does not determine the direction of the leaf-bearing limbs. This tree (referring to illustration) can be worked around as easily as it could be if it only had one long trunk. In fact, branches which start high from a trunk are very apt to become horizontal and to droop. There must be a certain number of scaffold limbs to form the head. If these limbs are taken out comparatively low, they may be trained in an upright direction and hold their weight and position. If they are started out very high they will not take such an upright direction, because the tree will not grow beyond its normal stature. High trained trees are often practically lowest headed."

FORM OF TREE.—The business of orcharding is not old enough to have developed systems of pruning which may be said to be characteristic of the state. The conditions existing in the fruit districts have been so favorable for the production of fine fruit that the growers have not felt the need of the finest development of the art. We have grown fine fruit whether we would or no. But now that competition is more severe and insects and diseases are multiplying more attention must be given to methods and systems of culture.

In pruning trees one of two ideals must be adopted, which are known as the pyramidal and vase forms. The former preserves the leader, which is made to form a central shaft to the tree. This style has the advantage of more bearing surface, as the leader grows and in time forms a "two-storied" tree. The objections to tall trees are apparent and need not be discussed here. The leader is done away with in the vase form and a few limbs, usually not more than five, are selected to form the top. A more or less open centered tree is thus formed, but by skillful pruning this space is occupied by branches of bearing wood. Very tall trees are thus avoided, but what is more important, such trees are not so apt to be destroyed by blight, as recently pointed out by Mr. Waite. Death to trees result when the blight germs gain entrance to the trunks and larger limbs. Such attacks are usually brought about by the presence of small limbs, water spouts or fruit spurs, which become diseased and which the germs follow till the main trunk or branch is reached. Should the leader of a pyramidal tree be attacked seriously enough to necessitate its removal the tree would be ruined, but by having

several main branches or trunks one of them might be spared without seriously crippling the tree. But the protection may be carried still further by keeping the main branches of the vase shaped tree free of all small limbs and fruit spurs which are so susceptible to attacks of blight.

SHAPING THE NEWLY PLANTED TREE. — The term low headed, is a relative one, but a top may be considered low when the first branch is thirty inches from the surface of the ground. Some of our successful growers prefer higher heads than this, while others start them lower. Our own preference is for a trunk about twenty inches in height. But whatever height is determined upon, the tree must be cut back preferably, just after it has been planted. Should the tree be supplied with suitable limbs at the point where the head is desired three to five of them, properly spaced, should be selected to form the frame work of the tree. The rest are removed. The selected branches should then be shortened in to a sound bud within a few inches of the main stem. But ordinarily the lower branches are pruned off in the nursery so that we seldom get a tree from which suitable branches may be selected. In this case the entire top should be removed without regard to branches, making the cut a foot to eighteen inches above the point where the lowest limb is wanted. In doing this it is expected that branches will push out below in sufficient numbers so that suitable selections may be made. For this reason strong yearling trees are always preferable to older ones and in fact apple trees of this age are now commonly used in California. Should suitable branches fail to grow, one of the lower branches which nearly always form, must be developed to form a new head.

The trees should be gone over several times during the first summer to remove surplus shoots and especially those which push out far below the point where the lowest branch is wanted. Occasionally some of the upper branches develop a vigorous growth at the expense of the others. These should be headed back so as to give all a chance to develop, otherwise some of the important scaffold limbs may be found to be very weak at the close of the season.

When a branch is headed back great pains should be taken to make a slanting cut just above a sound bud. If made too far above the stub will die back at least as far as the bud, and often farther. If made too close, the bud may be so injured that a stub is formed which will die back at least to the next sound bud.

As soon as the trees are planted, then the top should be cut back as described above. Ordinarily a profusion of branches will be pushed out which may be allowed to grow as they will during the first season or they may be cut back to one or two buds. By the time these branches begin to grow the roots are established in the soil and new ones formed so that an adequate supply of plant food is

provided. It will be remembered, however, that the plant cannot use this food until it has been made over in the leaves. It is for this reason that a large leaf surface is necessary and it is also desirable in that the shade forms a protection from the sun.

The kind of top which the tree is to assume is developed with the first season's pruning, which should be begun in most sections not earlier than the first of March. This is true for the reason if done earlier a longer time must elapse before the wounds can heal and necessarily the cut surfaces are exposed that much longer to the drying action of the sun, wind and frost. It is commonly understood among orchardmen that trees must not be pruned when the wood is frozen. Pruning when the trees are in this condition often results in bad wounds and the dying back of branches, but this result is probably due to the agencies just mentioned rather than to the fact that the wood was frozen. In any case the rule is a good one to follow. Then, too, there is always more or less danger from winter killing after early pruning is done so that the trees would need to be gone over a second time.

From three to five limbs are now selected to form the framework of the tree which should be cut back about twelve inches from the trunk. The rest are removed. If the lowest branch has been taken out at twenty inches from the ground, the highest branch should be at least a foot above; two feet would be better. A common mistake is to cut trees back too far thus crowding the branches as shown in plate I. Neither were these branches thinned out nor headed in during the first season but were all allowed to develop into leaders. This latter mistake often results in long willowey branches which droop with a load of fruit and is the main reason for condemning low headed trees. Many growers carry their pruning up to this point successfully, but fail to head in the first season's growth and so miss one of the critical points in the proper formation of the top.

It is a common notion that the branches gradually get higher from the ground as the tree continues to grow. The apparent gain in height is due solely to the increase in diameter of the limbs which soon begin to crowd if sufficient space has not been left between them. The centers of the limbs will always remain the same distance apart, so in forming the head one should have in mind what the appearance of the limbs will be when they have attained a diameter of six or more inches.

SECOND YEAR:—It may be regarded as a rule, that when a limb is cut back, unless the cut is made just above a strong lateral, two or more branches will develop near the cut end and some of the buds lower down will develop into shoots. The usual practice is to allow two of these to grow on each of the previous years limbs to form additional framework for the tree. The two selected should

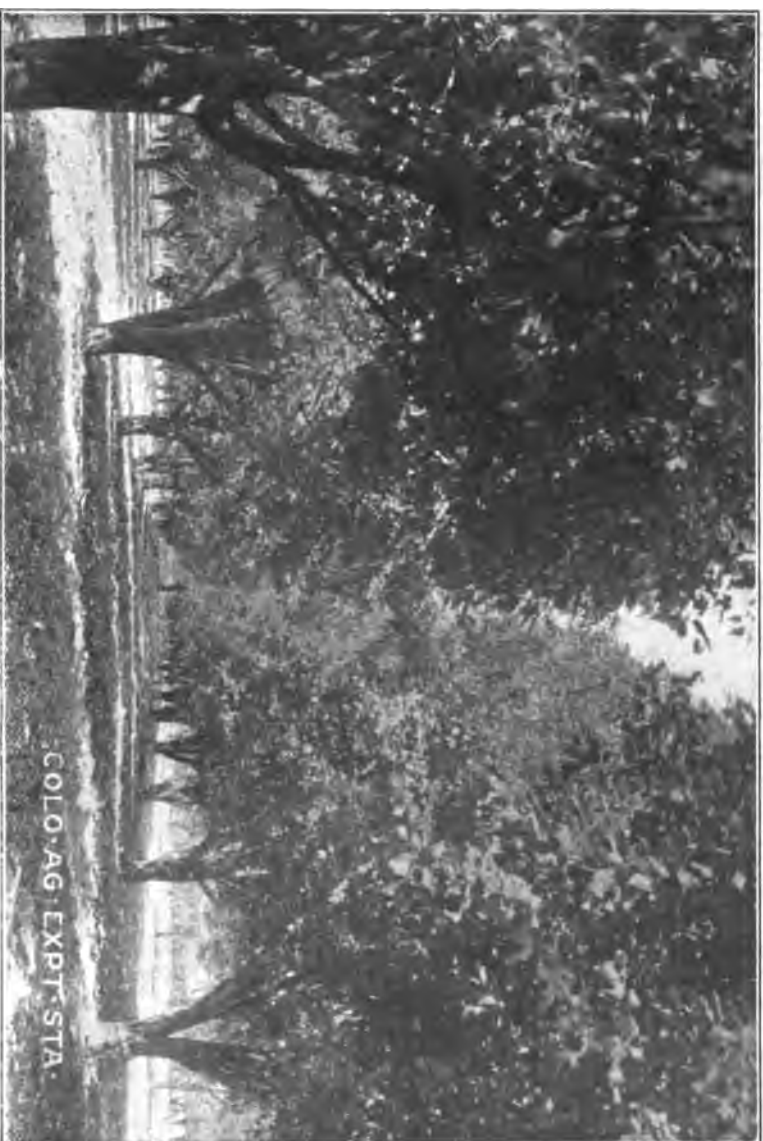


PLATE I.—LOW HEADED TREES WITH ASCENDING BRANCHES.

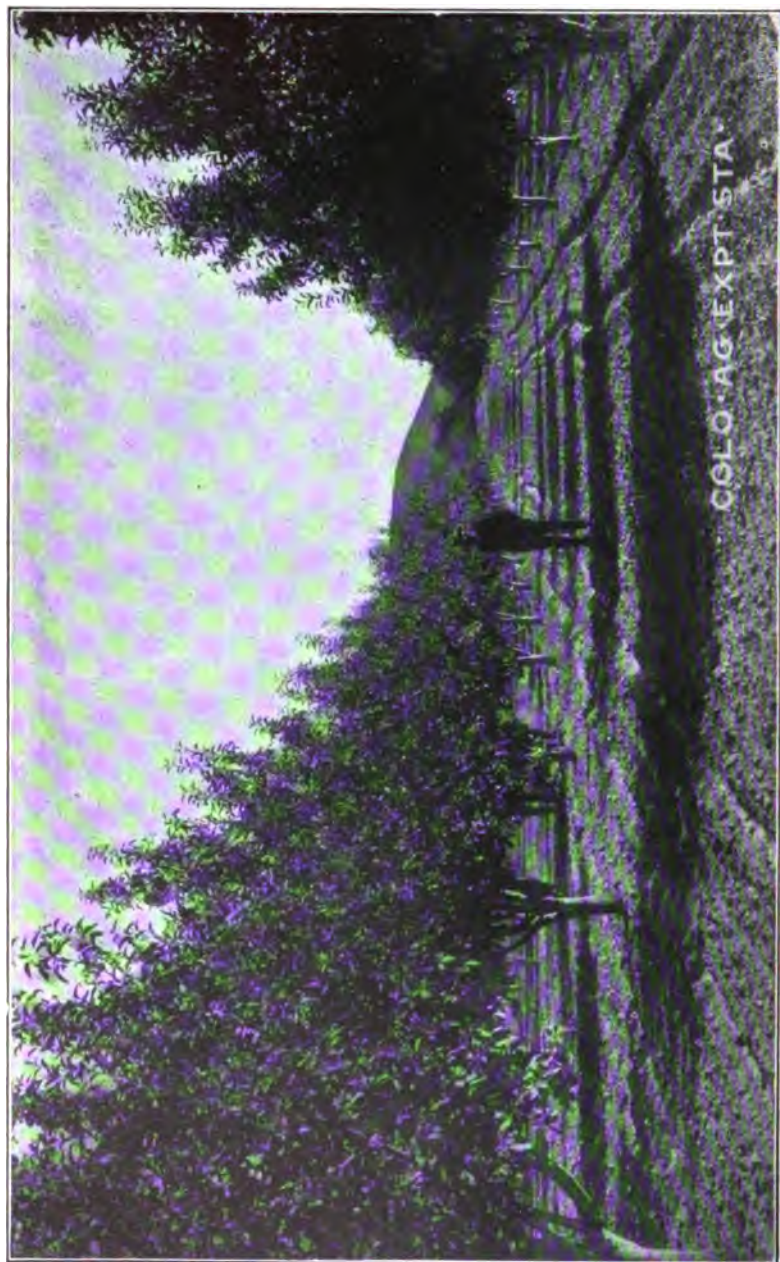


PLATE II.—YOUNG APPLE TREES WELL HEADED IN.

be some distance apart, one at the end and one farther back, and so placed that the development of crotches will be impossible. They are now cut back from a half to two-thirds of their growth and the laterals are shortened to one or two buds so that they may later develop fruit spurs and also shade the branches with their cluster of leaves. If too many have formed, some of them should of course be removed. On the other hand if we are to develop Mr. Waites' idea of making the tree more resistant to blight these laterals should all be removed and so carry the fruit bearing wood farther away from the trunk and main branches.

Some growers object to heading in trees at all, for the reason that all of the buds are likely to develop into branches and so the formation of fruit spurs is retarded and the surplus branches must be cut out. But it is highly desirable that all of the buds should develop and then by heading them back to spurs, as just mentioned, the formation of fruit spurs is largely under control of the pruner.

Any tendency toward one-sidedness may to some extent be corrected and open spaces filled in by selecting branches that are already growing in the general direction of the vacancy. Then by cutting to a bud, which is on the side toward the opening, such faults may gradually be overcome.

THIRD YEAR:—The frame work of the tree should now be well formed so that it will require less attention from this time on. Surplus branches and those that rub or are inclined to form crotches should be removed. Very vigorous growths should also be headed in.

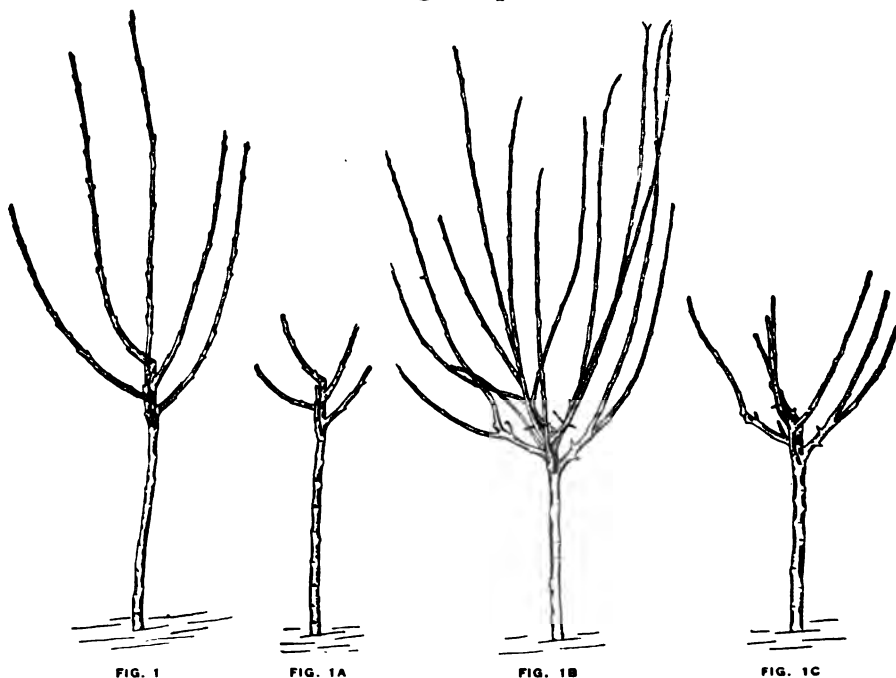
Thus far our discussion has been confined to the shaping of open or vase formed trees. If a leader is desired, the treatment is practically the same, except that the upper shoot is allowed to grow with little heading in. Branches are allowed to develop on this leader at proper intervals, using the same care as to location, pruning and development as in the former case.

A discussion of some photographs of actual experience in pruning young trees will help to review and fix the points of the different stages of pruning in mind. These were second grade trees and were evidently three years old when planted. The lower laterals had all been pruned away in the nursery so that the tops were much too high for Colorado. There was also difficulty in getting branches to form at suitable places from which to make the selections for the head. However, the results are much better than as though the tops had been left as received from the nursery as is so often done.

The trees in figures 1, 2 and 3 were all headed back to about 24 inches in April, 1904. This left them mere stubs. Had there been any laterals below this point they would have been pruned back to single buds so that clusters of leaves might have formed and thus provided some shade for the trunks. These pictures show

how the trees looked in April, 1905, at the time of the first pruning. No. 1 had formed five vigorous branches, No. 2 produced four and No. 3 but two.

The five branches on No. 1 were saved to form a framework for the tree and were cut back to about one foot in length. These are well distributed about the trunk, but have the fault that they are too close together. The lowest limb might well be double the distance from the top that it now is. No. 1a shows No. 1 after it was pruned, with the idea of making an open-centered tree.



No. 2 is also open to the objection that the limbs are too close. All of these were saved to form the frame work of a tree with a leader as is shown in No. 2a. The only difference between this and No. 1a being that the topmost branch was left longer than the others. The pruner of this tree is open to severe criticism in that he has allowed three vigorous limbs to grow from near the surface of the ground. These limbs could serve no useful purpose and so only rob the other limbs of plant food. Such growths are best prevented by pinching off the buds early in the season.

No. 3 failed to throw out enough branches to form a suitable top. The two which were produced are nearly opposite, so that a bad crotch would soon result. Both branches were cut back to the second bud, as shown in 3a, in the hopes of inducing dormant buds to push out lower down.

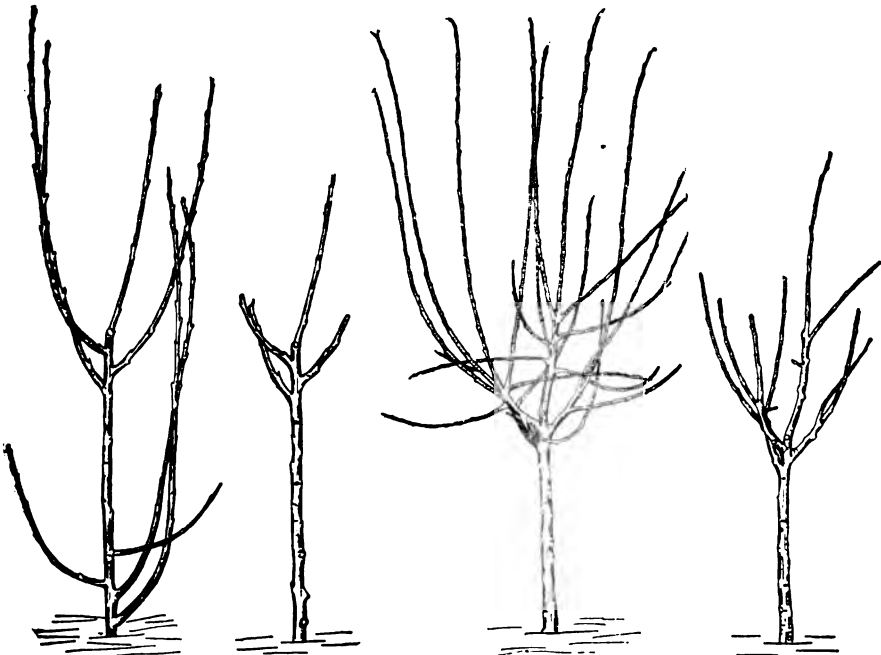


FIG. 4

No. 4 shows one of this lot of trees that was left unpruned. Notice the weak spindling growth and short laterals as compared with the others. There is small chance of making a decent tree out of such a specimen even though it should live. Such illustrations as this, which may be seen on every hand, should prove to any one that all trees should be headed back when planted, if for no other purpose than to induce a vigorous growth.

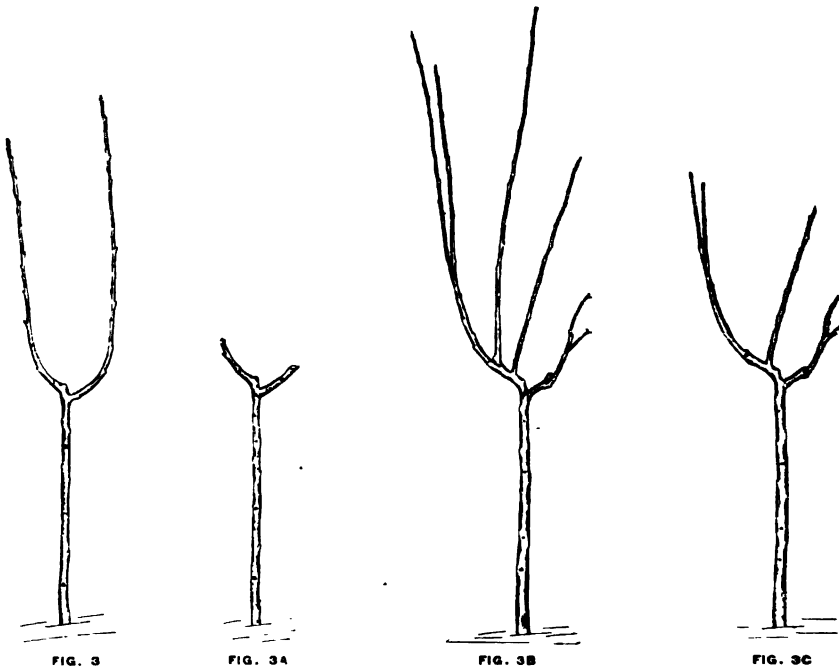
At the close of the season of 1905 the pruned trees had made a growth respectively as shown in 1b, 2b and 3b.

Pruning should, of course, be done in late winter or early spring, but these trees were pruned for the purpose of illustration and the results are shown in 1c, 2c and 3c. Tree No. 1 has now taken the form shown in 1c. One of the scaffold limbs seemed superfluous so it was removed and the new growth, shown in Fig. 1b, was cut back about one-half. The few side shoots were cut back to a single bud with the idea of developing fruit spurs. During the season of 1906 numerous branches should develop on all of these scaffold limbs. As a rule two of the best placed of these secondary limbs will be selected on each of main scaffold limbs to form additional framework. The rest may be removed or cut back to develop fruit spurs as may be



The form of the tree then, should be developed at the beginning of the season of 1907 and subsequent pruning should be directed toward retaining this shape, cutting back excessive growths and thinning and renewing the bearing wood.

The pruning of tree No. 2 is much the same, except that a leader is being developed. Fig. 2c shows that although the top was cut back the same as Tree No. 1, the topmost branch is developing into a vigorous central shaft. The first set of scaffold limbs have been formed and a second set is to be developed at a suitable distance above. The new growth is to be cut back the same as has been described.



The tree shown in the series 3-3c is, so far, pretty much of a failure. The severe heading given it in the spring of 1905 failed to make branches develop lower down. It would have been a better plan to have inserted two or three buds at suitable points around the main stem in June, 1905. This can probably be done next June, but the chance for success is not so great. Limbs can be developed by this means just where they are wanted, but the average person will succeed better with trees which do not require such manipulation.

PRUNING BEARING TREES.—The form of the young tree should be well established after the third season. From this time on the question of pruning is simply to retain so far as possible the

form we have started, to prevent the formation of crotches and cross branches, to thin out an excess of branches so that sunlight may be admitted and the amount of bearing wood reduced and renewed.

One of the peculiar effects of high altitude, with the accompanying sunshine on plants, is that it induces fruitfulness and early bearing. Many varieties of apples produce paying crops when the trees are six years old and the tendency of young trees to overbear annually is pronounced. We therefore are rarely obliged to prune to induce fruitfulness. Should such an occasion arise, the following should be borne in mind: Prune in summer to induce fruitfulness and in winter to promote wood growth. This is true for the reason that summer pruning checks the growth of the tree by removing a portion of the leaf surface. An injury of any kind will have the same effect, likewise a weak growing or sickly tree should be severely headed in while still dormant in order to induce a vigorous top growth.

Thin out the top then every year. No general rule can be given as each tree presents a different problem. A thick growth of branches results in weak bearing shoots and spurs. And finally when cutting back limbs on bearing trees the cut should be made just above a strong lateral wherever possible. The tendency of the sap will be to flow into the lateral and thus prevent the formation of numerous branches which nearly always results when a so-called stub-cut is made.

A number of our best varieties of apples are apt to develop long slender branches which may bend and rest on the ground and indeed it is not uncommon for such branches to break under a load of fruit. Some of these kinds like the Wine Sap are very apt to overbear periodically as they get older, often to such an extent that the branches are broken down with a load of undersized fruit. It may take such trees two seasons to recover from the effect of overbearing, but the third year the process may be repeated. A severe heading in and thinning out of the branches would largely correct these faults, and make it possible for the trees to bear annual crops of fine fruit.

But one should become well acquainted with the habit of growth of different varieties as a few kinds grow slowly and will not bear heavy pruning. Others are erect growers and some are spreading. One cannot expect to entirely overcome such tendencies but they may be corrected to a marked degree. The upright varieties may be spread somewhat by pruning to the outside laterals and the spreading kinds may be contracted by cutting to those which have an inward direction. And by cutting back the vigorous growths each season, those two feet and over in length, the limbs are made stocky thus in great measure doing away with drooping branches. However, we believe, that under our conditions, it is advantageous

in many ways to keep trees from becoming very tall. This can only be done by intelligent annual pruning. In Plate II. is shown a photograph of a successful young Colorado orchard that has been severely headed in.

Thus far our discussion has had to do entirely with apple trees. The same principles apply to most of the other fruits with the exception of those like the peach which bear fruit on last season's wood. The pear is pruned much the same as the apple, as are also the blue or domestica plums. The latter should be headed lower and they require much less attention after the character of the top has been formed. The sour cherry and red or cultivated varieties of American plums require almost no pruning. The tops should be very low.

PRUNING THE PEACH.—Peaches are borne on wood of the preceding year's growth, consequently the training from the beginning should be somewhat different from that given our other common fruit trees. The importance of peach growing in the state will warrant a brief description of methods of training and pruning.

We must have the tops low, twelve to eighteen inches of clear trunk being ample. In fact the trees in some of our best orchards are headed just above the surface of the ground. For this reason medium sized, well grown yearling trees are always preferable to two year old trees, or to overgrown trees of the same age. The limbs on large trees are nearly always cut off from the lower portion in the nursery so that it is rarely possible to make branches grow where they are wanted by heading back.

Take for example a nursery tree that is provided with suitable laterals for forming a top. As soon as the tree is planted, cut the top back to from twenty four to thirty inches from the ground. Then reduce all of the laterals to spurs of from one to three buds. Many of the remaining buds will soon start into active growth so that a large number of small shoots result. The foliage will not only protect the trunk from the sun but a large leaf surface is necessary for the preparation of plant food. The second spring after planting the trees receive their first pruning and the formation of the top begins. Select from three to five of the strongest and best placed branches to form the frame work. If the lowest one is fifteen inches above ground the upper one may well be twelve to fifteen inches higher. The intervening ones should be well spaced between and symmetrically arranged around the stem so that there will be no open spaces, one-sidedness or crotches. These limbs, no matter how vigorous their growth may have been, should be cut back a half or two-thirds of their length, while all of the rest are removed entirely. By making these main limbs short they become stout and stocky and the load of the matured top is borne close to the central trunk so that the strain is materially lessened.

Should the nursery tree be lacking in laterals at the proper height the top must be cut back anyway if we are to have a low head. If the lower laterals have been pruned away in the nursery there will be difficulty in securing branches from which a well balanced head may be formed. One must take this risk. Should suitable branches appear they are headed in as above. If no branches at all are pushed out where wanted, or those that are formed are so situated as to make the tree very much one-sided, a branch from near the surface of the ground will nearly always develop, which can be used to form a new trunk and top. This should be treated the same as a newly planted tree and in three or four years it cannot be told from the rest.

During the second and third years the pruning and trimming does not differ materially from that already described. The laterals should not be too thick, but enough should be left to produce a good bearing surface low down. The trees should be pruned each year from now on, heading in the main branches and vigorous laterals from a half to two-thirds of their growth and thinning out laterals where too thick. Always head back to a good lateral wherever possible and so prevent the growth of surplus shoots. In any case, short branches should be encouraged to grow low down on the trunk and branches to provide protection from the sun.

It is a mistake not to keep the branches on peach trees well cut back, for if this is not done and the laterals which produce the bearing wood grow farther from the body of the tree each year, which finally results in long, bare branches with a tuft of bearing wood at the end. Neither should the attempt be made to cut the branches back evenly all around the tree, but each branch should be considered as a separate problem.

Should trees become too tall to be handled to advantage, new tops can be secured by cutting back all of the limbs at the time the pruning is usually done. A luxuriant growth will push out from these stubs so that but two seasons of fruit bearing will be lost.

Precaution needs to be taken, however, not to cut off too large limbs, especially on old trees. Neither should a small limb be cut back too close to its junction with a large limb. Perhaps the best results will follow if none of the limbs are larger than two inches in diameter at the point where the cut is made. The stubs should be left from about two to four feet in length, depending upon the age of the tree, the size of the limb and its location. Too severe heading in may easily result in the death of the tree.

Press Bulletin No. 22, October, 1905.
The Agricultural Experiment Station
FORT COLLINS, COLORADO.

A Co-Operative Experiment in Tree Planting.

BY W. PADDOCK AND B. O. LONGYEAR.

The planting of trees for posts and fuel is a subject in which the farmers of Colorado are doubtless interested and yet it is one which has not received the attention which it deserves. So long as land holdings were large and but few fences were required the supply of native timber was found ample. But with the division of our agricultural lands into smaller areas, requiring a greatly increased amount of fencing material, the original supply is being so rapidly reduced that in some parts of our state the price of posts has doubled within the last few years. In fact it is evident that we must soon look to some other source than the natural timber growths of this state to supply this increasing demand for such material. The Experiment Station, therefore, is about to enter into a co-operative timber planting experiment with a few land owners in various parts of our state during the coming season.

PURPOSE OF THE EXPERIMENT.

The purpose of the experiment is primarily to determine the adaptability of certain species of utility trees to the various parts of our state. The data thus secured will then be available as information for those who seek the advice of the Station in the matter of planting such trees. It is also purposed to establish a number of small plantations which may serve as examples in tree planting for timber and afford object lessons in their proper management. It is finally the aim, by means of this experiment, to encourage and promote the planting of utility trees wherever in our state they are capable of successful growth. It is thus hoped that farmers will be induced to make timber plantations from which they may cut their own posts, and to a certain extent their fuel, within the next decade.

Trees Selected:—The trees selected for this experiment are the Hardy, or Western Catalpa, (*Catalpa speciosa*) and the common or black locust (*Robinia pseudacacia*.) These two species have been selected because they promise well for the purpose mentioned. Thus they are relatively hardy, grow rapidly under favorable conditions, and resist decay remarkably well when in contact with the soil. The locust, moreover, is of good fuel value. By growing the catalpa two seasons and cutting back to the ground in winter or early spring a growth of vigorous, straight shoots will arise which will form good trunks for posts or poles. Both species sprout readily from the stumps when cut in winter and by leaving the strongest shoots the plantation is thereby readily renewed.

CONDITIONS OF THE EXPERIMENT.

(a) One plantation of three hundred trees of each species is to be established in each of twenty representative localities in the state.

(b) Each plantation will be put in charge of some responsible land-owner who volunteers for that purpose. He will be expected to furnish and fit the ground, set the trees, irrigate, cultivate and prune them according to instructions, and to keep a record of their growth from year to year. A report is to be made to the Station, when requested, upon the progress of the experiment.

(c) The experiment Station will furnish the trees for the experiment (300 of each species) f. o. b. cars Ft. Collins, and supervise the planting and give occasional supervision during the period of the experiment. It is believed that at the end of ten years the trees will be large enough to furnish from two to four posts and stakes each in addition to some fire wood. This estimate is based on measurements of trees grown in western Kansas and is not in excess of the record of such trees now growing in this state.

• *Plan for Planting:*—On irrigated land it is planned to set the trees of both species in rows six feet apart and four feet apart in the row thus covering about one-third of an acre with the six hundred trees. Where the conditions are like those on the plains and water for irrigation is not available the planting will doubtless need some modifications in this respect by allowing more space for each tree. Under such conditions the trees should be set in as compact a form as possible and frequent, shallow cultivation given. The trees for this experiment are now growing on the Agricultural

College grounds, having been set last spring when two years old from seed, which is a convenient size for planting.

Although it is intended to furnish only enough trees from the Station supply to set one plantation in each locality it is hoped that it will be the means of encouraging many farmers to start similar plantations themselves. Thus the following brief directions and suggestions have been prepared to aid in this matter.

STOCK FOR PLANTING.

While it is possible for the farmer to grow his own seedlings it is doubtful if this is advisable. Black locust seedlings two years of age can be purchased very cheaply from the principal nurseries, and this is a suitable size for planting. The securing of the true hardy catalpa, however, is an uncertain matter and unless this is done almost certain failure will be the result in this state.

PREPARATION OF THE LAND.

Directions The land for this purpose should not be land that has no usefulness for crop-growing, although very rich and heavily watered soil is not desirable. The ground should be fitted by fall plowing if possible and well harrowed in spring, but land that has been in cultivation for one or more seasons is better than newly broken land. It should be free from weeds and grass at time of setting the trees, in fact the preparation should be the same as for setting an orchard, which will greatly facilitate the matter of setting the trees and tending them later on.

Planting—The best time for setting trees in this state is undoubtedly in spring. Trees planted in autumn, unless the work is done at just the right time, are in danger of being killed by drying out. When ready for planting the young trees should have all broken and bruised roots trimmed off with a sharp knife so they will heal more readily, and at the same time the top should be cut back to correspond to the reduced root system thus balancing the two and ensuring the least amount of loss from drying out. The holes for setting should be deep and wide enough to allow the roots to be spread out fully and as the soil is put in it should be carefully packed among the roots so there shall be no air-holes. This is best accomplished by using a stake with rounded end although the foot can be successfully used to pack the soil as fast as it is thrown in. Seedlings and very small trees can be rapidly planted by two persons. One makes the holes by pushing the blade of a spade almost vertically into the soil to the depth of a foot or more and pushing the handle forward. The other person then inserts the roots of the tree behind the spade, which is then withdrawn and the soil pressed firmly back with the foot. If the planting is to be done on a bright, dry day care should be used to keep the roots covered with moist burlap or they may be heeled in temporarily to prevent drying out. The trees when set should be a little deeper than when in the nursery and a shallow depression about each one will help to retain moisture. Ordinarily as soon as the trees are set water should be turned on, which will further settle the soil about the roots and encourage their growth. Irrigation should be given only as often as necessary to keep the soil moist and the trees growing well. And after each irrigation or rain the soil should be given shallow cultivation to break up the surface and form a dust mulch. Where trees are being grown without irrigation this matter of surface cultivation is extremely important, as by this means the soil moisture is largely retained for the use of the trees instead of being lost through evaporation. This cultivation should continue until the trees are well established and until they shade the ground well which will probably not be accomplished in less than three seasons.

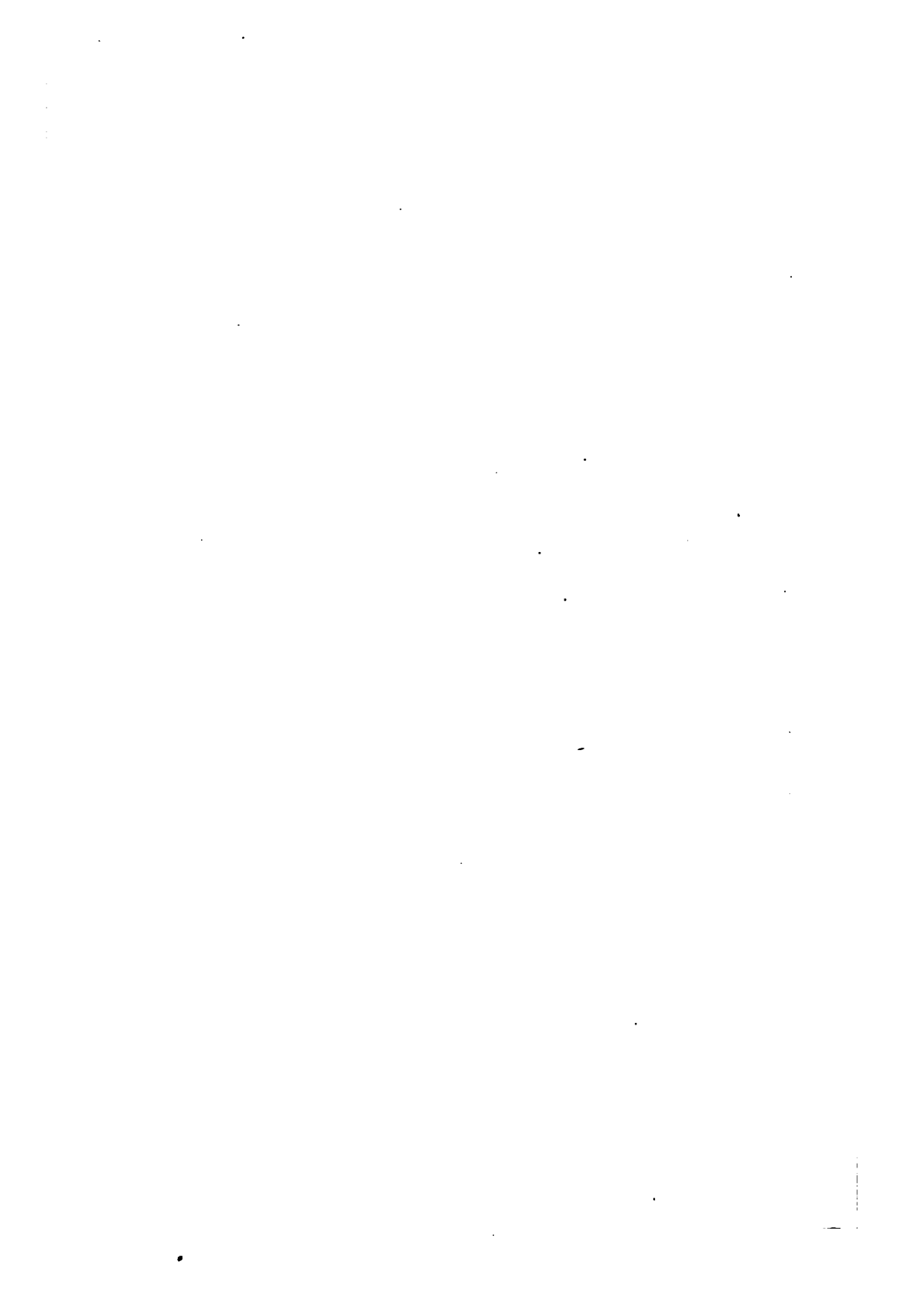
For the production of posts and fuel tall trunks free from branches are desired. To secure these pruning will be necessary as long as culti-

vation is kept up, after which the side branches will mostly die back. The trees along the north and west sides may be allowed to retain their lower limbs which will act to some extent as a windbreak. In some cases trees can be successfully grown along ditches and roadsides but cultivation is then not so readily given.

The trees should not be set where stock can get at them, for browsing animals are sure to greatly injure them by eating off the young growth beside breaking them down by rubbing and trampling. If the plantation cannot be situated in a field not used for grazing purposes then a fence should be put around the area devoted to this purpose.

Any land owner who desires to undertake such an experiment is requested to correspond with B. O. Longyear, Assistant Horticulturist, who will have these experiments in charge. In making application kindly state the kind of soil it is proposed to use, location, (Section, Township and Range) whether it is on the home farm or otherwise, elevation above sea level if possible, facilities for irrigation, and whether you are willing to care for the plantation as stated above.

If more applications are received than we have trees to supply, preference will be given to choice of location and condition which promises best success. However, it is hoped that all will correspond with us who are interested in the plan even if trees cannot be furnished at this time, the interest shown may be the means of future co-operation.



**THE STATE AGRICULTURAL COLLEGE
OF COLORADO**

THE EIGHTEENTH ANNUAL REPORT

OF

**The Agricultural Experiment
Station**

For 1904-5

LETTER OF TRANSMITTAL.

To His Excellency,
JESSE F. McDONALD,
Governor of Colorado:

In accordance with the requirements of an Act of Congress providing for the establishment of agricultural experiment stations, I have the honor to present herewith the report of the Colorado Experiment Station, it being the eighteenth annual report. The report of the activities of the Station is for the whole year, while the fiscal report ends with June 30, in conformity with the fiscal year of the United States.

The report and the accompanying documents give an indication of the activity of the Station. The publication of the experiments is made in separate form as bulletins which are widely distributed among the agricultural population of the State.

Respectfully submitted,

L. G. CARPENTER,

Director.

The Agricultural Experiment Station,
State Agricultural College,
Fort Collins, Colo.
December, 1905.

The Agricultural Experiment Station,

FORT COLLINS, COLORADO.

THE STATE BOARD OF AGRICULTURE.

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HON. EUGENE H. GRUBB, - - - - -	Carbondale. 1911
HON. A. A. EDWARDS,†††	Fort Collins. 1913
HON. R. W. CORWIN,†††	Pueblo. 1913
GOVERNOR JAMES H. PEABODY,**	} <i>ex-officio</i> .
GOVERNOR ALVA ADAMS,***	
GOVERNOR JAMES H. PEABODY,****	
GOVERNOR JESSE F. McDONALD,†	
PRESIDENT BARTON O. AYLESWORTH,	

EXECUTIVE COMMITTEE IN CHARGE.##

P. F. SHARP, *Chairman*.
 B. F. ROCKAFELLOW. JESSE HARRIS.

EXECUTIVE COMMITTEE IN CHARGE.

P. F. SHARP, *Chairman*.
 B. F. ROCKAFELLOW. A. A. EDWARDS.

STATION STAFF.

L. G. CARPENTER, M. S., <i>Director</i> , - - - - -	IRRIGATION ENGINEER
C. P. GILLETTE, M. S., - - - - -	ENTOMOLOGIST
W. P. HEADDEN, A. M., PH. D., - - - - -	CHEMIST
WENDELL PADDOCK, M. S., - - - - -	HORTICULTURIST
W. L. CARLYLE, B. S. A., - - - - -	AGRICULTURIST
G. H. GLOVER, B. S., D. V. M., - - - - -	VETERINARIAN
W. H. OLIN, M. S., - - - - -	AGRONOMIST
C. J. GRIFFITH, B. S. A.,§ - - - - -	ANIMAL HUSBANDMAN
J. A. McLEAN, A. B., B. S. A.,|| - - - - -	ANIMAL HUSBANDMAN
R. E. TRIMBLE, B. S., - - - - -	ASSISTANT IRRIGATION ENGINEER
F. C. ALFORD, M. S., - - - - -	ASSISTANT CHEMIST
EARL DOUGLASS, M. S., - - - - -	ASSISTANT CHEMIST
A. H. DANIELSON, B. S., - - - - -	ASSISTANT AGRICULTURIST
S. ARTHUR JOHNSON, M. S., - - - - -	ASSISTANT ENTOMOLOGIST
B. O. LONGYEAR, B. S., - - - - -	ASSISTANT HORTICULTURIST
P. K. BLINN, B. S., - - - - -	FIELD AGENT, ARKANSAS VALLEY, ROCKYFORD

OFFICERS.

PRESIDENT BARTON O. AYLESWORTH, A. M., LL. D.
 L. G. CARPENTER, M. S., - - - - - DIRECTOR
 A. M. HAWLEY, - - - - - SECRETARY
 MARGARET MURRAY, - - - - - STENOGRAPHER AND CLERK

† Term expired April 25, 1905.

†† Resigned April 25, 1905.

††† From April 25, 1905.

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† To April 25, 1905.

†† From April 25, 1905.

§ Resigned August 1, 1905.

Appointed August 1, 1905.

FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1904.

RECEIPTS.

Dr.	U. S. Fund.	Special Fund.	Total.
From the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1905, as per act of Congress approved March 2, 1887.....	\$15,000.00	\$.....	\$.....
Balance on hand July 1, 1904.....		479.40	.....
Miscellaneous		488.35	.....
Total receipts			\$15,967.75

DISBURSEMENTS.

Classification.	U. S. Fund.	Special Fund.	Total.
Salaries	\$10,863.30	\$ 10.00	\$10,873.30
Labor	211.61	31.00	242.61
Publications	1,780.93	150.00	1,930.93
Postage and stationery	356.02	2.70	358.72
Freight and express	7.30	.....	7.30
Heat, light, water and power .....		.....	.....
Chemical supplies .....		.....	.....
Seeds, plants and sundry supplies	344.11	.10	344.21
Fertilizers	30.20	.....	30.20
Feeding stuffs .....		.....	.....
Library	42.69	.....	42.69
Tools, implements and machinery.....	16.60	.....	16.60
Furniture and fixtures	46.40	.....	46.40
Scientific apparatus	265.27	35.00	300.27
Live stock	428.06	.....	428.06
Traveling expenses	586.51	32.90	619.41
Contingent expenses	21.00	20.00	41.00
Buildings and repairs .....		.....	.....
Total expended	\$15,000.00	\$281.70	\$15,281.70
Balance		686.05	686.05
Grand total			\$15,967.75

REPORT OF THE DIRECTOR.

The Experiment Station was organized in 1888, under the provisions of an act of Congress commonly known as the Hatch Act. The conditions of the act were accepted by the legislature in 1889. By this Act \$15,000 is furnished annually by the General Government for research work or experiments bearing directly on the agricultural industry, having due regard to the varying conditions and needs of the respective states. This appropriation is available solely for the necessary expenses of conducting investigations and experiments and printing and distributing the results. In no case is a sum to exceed five per cent. to be used for buildings. The Station is given the privilege of sending its bulletins without postage under the signature of the Director.

The Station was organized in 1888, and as the agriculture of the State is necessarily dependent upon irrigation, that branch was given a prominent place in the establishment and has since continued. Other lines of investigation provided for were in agriculture, horticulture, chemistry, and veterinary science. Afterwards entomology was added and veterinary was abolished and again made a part of the Station in later years. At the time of organization it was thought, mistakenly, that an important feature of the work would be in the maintenance of permanent substations in different parts of the State. It was soon seen, however, that the cost of these substations was entirely disproportionate to the results; more than that, the conditions were not such as could be met. Many expected these substations to be model farms. People wanted experimentation in their own lines of agriculture in which they were interested, and practically expected a specialist in each of the different lines, a condition which no one man could meet. The General Government finally ruled that the appropriation under the Hatch Act was not available for permanent substations; that the appropriation was for *an* experiment station, not several, and that while it might be available for investigations which might, if necessary, be conducted in different parts of the State, yet none of it could be used for the purpose of farming or for permanent substations. Accordingly, when the present Director took charge of the Station one of the first problems was to withdraw from the various substations, with as little friction or conflict as possible. The men who had been superintendents of the

substations were freed from any responsibility for farming and given special investigations, and their work immediately became fruitful. The substations had been a very great draft upon the revenues of the Station. A total expenditure of practically one-half of the revenues of the Station had been made in this way, and the results had been almost nothing. It had developed that the substations took a large part of the available resources, and the investigational departments of the Station were seriously crippled and were left with practically no means for taking up or continuing the investigations in which they could be useful.

In the last ten years this condition has gradually been changed. The substations have entirely ceased to be a draft upon the revenues of the Station. A part of the land has been sold and others leased, and arrangements so made that the Station is not responsible for the conduct of farming operations. The area which originally formed a part of the substation at Rockyford has mostly been sold; the tract remaining is simply used as a residence for the Field Agent and a small plot of ground used for experiments in connection with certain specific lines, principally cantaloupes and sugar beets. The intention, however, is that this shall not confine the Field Agent to that point, but that a large part of his work shall be in the Arkansas Valley. The only cost now is the salary of the Field Agent, who as an investigator is assigned certain problems in that region, and the former station is furnished him as rent. The land constituting the former substation at Cheyenne Wells is still retained, but for a number of years it has caused no expense. The work of the last Field Agent was devoted to the Plains, and as such developed many of the conditions of the Plains, which resulted in a series of bulletins and in the starting of the Macaroni or Durum wheat industry.

The publications of the Station have correspondingly increased in number. During the first eleven years only fifty-two bulletins were issued, and in the six years since fifty-five bulletins have been printed, besides a large number of smaller bulletins, which, for convenience, have been termed press bulletins. The sums formerly taken by the substations have been available as a working fund, increasing the effectiveness of the Station, while before the tendency towards economy frequently made it necessary to economize even in publication. It has also made it possible for the investigators to visit different parts of the State when conditions made it desirable. The size of the editions has gradually increased until now most of the bulletins are published in editions of from nine to ten thousand. The number of names in the mailing list is nearly eight thousand. The bulletins are sent without cost to all who apply. The distribution of bulletins has been the subject of much

thought to the Station authorities, and no completely satisfactory method has been found. A large proportion of the bulletins necessarily falls into hands that do not use them. Such loss, however, seems to be incident to all methods of distribution. Nature scatters a thousand seeds in order that one may take root and grow.

We have taken pains to make our bulletins more frequent, shorter, and more direct. So far as important lessons are conveyed by bulletins, it is expected that they will be applied only by the more progressive men in a country, and that gradually the others will acquire the results by observation. Ordinarily it requires from five to ten years at least for important scientific results to be appreciated and applied. It is noticeable that bulletins that may be most popular when issued, have an ephemeral demand, and after a short time are never called for. On the other hand many of those which are not at all popular, yet include the results of honest, scientific work, have a permanent value, and the demand for them may be greater after ten years have elapsed than it was after one year. Apparently the value is more and more appreciated, and certainly the honest work involved is respected and is of value. The popular compilations are not without their value, but this demand ought not to blind us to the fact that they are temporary in character, are of little permanent value, and have little or no effect upon the agricultural practice of the country. The life of the Station has now been long enough to emphasize this lesson. The experiment stations in the States which have done the most earnest and thoroughly scientific work are those which are now the most thoroughly established in the good opinion of the agricultural community.

The number of pages that have been issued and distributed by the Experiment Station during the year is nearly 2,500,000. The bulletins issued during the year ending December 1, are twelve in number. The following is a list:

No.	Title.	Author.
93—44 pages.	Colorado Hays and Fodders—Digestive Experiment	Dr. Wm. P. Headden
94—86 pages.	(Technical Series No. 6.) Report of the Entomologist; Some of the More Important Insects of 1903 and an Annotated List of Colorado Orthoptera, by	Prof. C. P. Gillette
	II.—Some New Colorado Orthoptera, by....	Lawrence Bruner, of Nebraska.
	III.—Bees of the Genus <i>Nomada</i> Found in Colorado, by	T. D. A. Cockerell
95— 8 pages.	Early Cantaloupes, by.....	P. K. Blinn
96—28 pages.	Shade Trees of Denver, by W. Paddock and B. O. Longyear	
97—14 pages.	Feeding Steers on Sugar Beet Pulp, Alfalfa Hay and Farm Grains, by.....	W. L. Carlyle, C. J. Griffith, A. J. Meyer

98—22 pages.	Beet Worms and Their Remedies, by	.....C. P. Gillette and S. A. Johnson
99—16 pages.	How Can We Maintain the Fertility	of Our Colorado Soils? by.....Dr. Wm. P. Headden
101—16 pages.	The Western Cricket, by.....C. P. Gillette and S. A. Johnson	
102—12 pages.	Feeding Steers on Beet Pulp, Alfalfa	
	Hay, and Ground Corn, by....W. L. Carlyle and C. J. Griffith	
103—32 pages.	The Thorough Tillage System for the	Plains of Colorado, by.....W. H. Olin
104—16 pages.	A Rust Resisting Cantaloupe, by.....P. K. Blinn	
105—12 pages.	A new Apple Rot, by	B. O. Longyear
Annual report, 1903-4.		

The number 100 was assigned to a bulletin on the Flora of Colorado, the manuscript of which was sent to the printer early in the year. This bulletin is one of several hundred pages, involves the results of the work done by the Station and College men on the plants of Colorado during a series of a great many years, and has taken much longer to get through the press than was expected. The preparation of the copy has been in the hands of the New York Botanical Garden, connected with Columbia College, New York City, the work being done by Dr. P. A. Rydberg, the foremost authority on Rocky Mountain botany.

When the number was assigned it was anticipated that it would issue from the press in its due order. The delay, and the number of other bulletins ready for printing in the mean time, will make it out of order when finally distributed.

The great area of Colorado, the variety of conditions, and the new problems brought by irrigated agriculture bring a great variety of questions for the Station to consider. These are far beyond the power of the Station to take up at any one time. Most investigations of value require from one to five or more years to carry through. Hence, only a limited number of specific investigations can be taken up at once. Of necessity the Station has to refrain from taking up many investigations which are of importance because they would interfere with other existing lines of investigation. This condition of things is likely to increase rather than decrease even with added revenue, for as the people appreciate the points where help may be obtained from the Station, their requests for aid will likewise increase.

The variety of conditions may be realized when the character of the State in comparison with other states is considered, as has been mentioned in a previous report. The area of Colorado is practically equivalent to the areas of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York combined. Its variation in elevation from 3,500 to over 14,000 feet induces extremes of climate as great as those between South Carolina and Spitzbergen. It has the new problems that come with a new country where there is no experience as to crops or

varieties which will be suitable; it has the variety that comes with both the plains and the mountains; it has the problems that come with irrigation, while agriculture in older countries becomes largely a search for fertilizers, under our conditions it becomes largely a search for water. Under the former conditions agricultural research is largely a chemical question, under our conditions from analagous reasons it may become largely an engineering question.

It is manifest that the fund for experimentation for such an area is small, and that only a limited variety of questions can be taken up. In the equivalent area above mentioned the United States supports seven experiment stations, with an appropriation of \$105,000. In addition the states themselves support two more. That the stations are recognized to be of value is shown by the fact that the state appropriations usually amount to more than those from the Government. Belgium, with an area of a little over one-tenth of that of Colorado, has sixteen experiment stations. As the Experiment Station becomes better known, as the men become trained for this work, there is bound to be an increase in demand. An obstacle in obtaining additional support from the General Government has been the claim that the states themselves ought to help support these stations. An encouraging step was taken by the last legislature in a bill signed April 6, 1905, which, besides furnishing some support for work in the Agricultural College, appropriated an aggregate of \$14,000 for the Experiment Station for the two years 1905-1906. This appropriation provides \$10,000 "to conduct investigations calculated to develop the beef, pork, mutton, wool, and horse producing interests of the State, and especially to devise and conduct feeding experiments intended to determine the most successful combination of stock foods, particularly in Colorado grasses, grains, and forage crops, and to discover the most economical and successful methods of maintaining animals and feeding them for the market; to investigate the various contagious and other diseases of live stock, especially of poisonous plants infecting the ranges of Colorado; to investigate live stock conditions, both at home and in other states of the Union, and to publish the results of such experiments and investigations."

Section 3 provides an appropriation of \$3,000 for the two years "to conduct co-operative experiments in the several sections of the State in order to discover the best methods of producing grain, forage, and grasses on the different soils and under the various climatic conditions of the State, for the purpose of improving the different varieties grown for the several purposes, and to publish the results of such experiments."

Section 4 makes an appropriation of \$1,000 "to investigate

and demonstrate the best method of fertilizing, seeding, and cultivating sugar beets, potatoes, and other root crops on the various soils of the different sections of the State; to experiment upon the production of sugar beet seed, especially adapted to Colorado conditions, and to perform such other experiments and conduct such other investigations as are calculated to increase the yield of potatoes and sugar beets and percentage of sugar in the beet crop, and to publish reports on such experiments."

None of this fund was available until late in the fall of 1905 after the growing season was past and as there was uncertainty whether it would be available at all, it was not safe to anticipate its payment.

Plans have been made by the various sections of the Station along these lines for the present winter and coming summer. Among these is one by Professor Carlyle, the Agriculturist, which involves a three years' test for comparison of different systems of wintering steers in Colorado. Sixty steers are to be selected this fall from different parts of the State, thirty of which are to be brought at once to the Station and placed on feed; the remaining thirty to be left with the ranchmen under range conditions. In a year fifteen more will be removed from range conditions and put on feed, and the next fall the remaining fifteen will be brought from the range and placed on feed. The object is to compare the different systems of wintering cattle as it affects the cost of beef production, the quality of the meat, etc. Other feeding tests include the value of sugar beets in fattening pigs; an experiment to determine the cost of wintering brood sows; comparison of foods for wintering steer calves.

The provisions of this section also enabled the Station to revive and continue an experiment on loco, which had been dropped for some years because of the conclusion which we reached that unless the investigation could be taken up on a much more thorough plan than we could afford it was better to leave loco alone. Considerable field work was done by Mr. Payne, and this work made clear the necessary conditions. The Department of Agriculture was interested in the same subject and a co-operative investigation was arranged whereby the Department furnished an expert from the Department of Agriculture, and this Station furnished horses and cattle for the test. Dr. C. Dwight Marsh, of the Department of Agriculture, has spent his summer at Hugo in this investigation, which is expected to continue for one or more years further. It was manifest from the previous work on loco that the first step necessary was absolutely to establish the connection between the plant and the so-called disease. A further reference will be found in the report of Dr. Glover, Veterinarian.

A further reference to the investigations of the different sections is found in their reports, which are appended. In most cases the reference to the work done is short. The financial report gives the statement of the expenditure of funds under the classification adopted by the United States. The expenditure for the sections for the fiscal period ending June 30, has been as follows. This does not include the expenditure for salaries or general purposes of the Station, like printing, stationery, postage, etc.:

Agricultural section	\$898.28
Horticultural section	328.74
Irrigation and Meteorology	359.13
Chemical section	64.18
Entomological section	253.55
Veterinary section	190.60

There is a bill now before Congress known as the Adams Bill, to increase the appropriation for experiment stations. The effect of this bill will be to increase the amount by \$5,000 the first year, by \$7,000 the second, and so on until the appropriation is \$15,000 more than at present after a period of five years. It is the hope that this bill will pass, for it will be of very great value to the Station.

INVENTORY AGRICULTURAL EXPERIMENT STATION, 1905.

DIRECTOR'S OFFICE

Office Fixtures & Equipment	\$1,278.06	
Stationery & Supplies.....	344.00	
Half Tones & Zinc Etchings.....	250.00	
Library	2,365.00	
		<u>\$4,237.06</u>

METEOROLOGICAL & IRRIGATION ENGINEERING SECTION.

Meteorological Instruments	650.90	
Office Fixtures	195.05	
Stationery, Books, Maps, Etc.....	49.05	
Irrigation & Hydraulic Apparatus.....	437.40	
Photo Supplies & Negatives.....	233.99	
Tools & Supplies for Soil Work.....	180.95	
Miscellaneous	358.18	
		<u>2,105.52</u>

ENTOMOLOGICAL SECTION.

Laboratory & Office Supplies	302.65	
Entomological Supplies	127.95	
Insecticides & Insecticide Apparatus	293.45	
Apiary	114.20	
		<u>838.25</u>

CHEMICAL SECTION.

Two Analytical Balances.....	150.00	
One Polariscope, one Beet Pulp Machine, one Beet Juice Press	250.00	
		<u>400.00</u>

HORTICULTURAL SECTION.

Glassware	7.40	
Photographic Apparatus	64.35	
Instruments	122.00	
Herbarium	1,640.00	
Tools	30.80	
		<u>1,864.55</u>

AGRICULTURAL SECTION.

Implements & Tools	193.05	
Miscellaneous	547.00	
Plant Industry Fund (marking set)	39.30	
Seeds & Grains.....		
		<u>679.35</u>

VETERINARY SECTION.

Kodak	18.90	
Stationery	2.00	
Stock at Hugo (Loco experiment).....	190.00	
		<u>210.90</u>

ROCKYFORD SUB-STATION.

Buildings & Improvements	1,484.00	
Farm Machinery & Tools.....	201.00	
Office Furniture & Fixtures.....	19.50	
Camera & Photo Supplies.....	30.00	
40 Acres Land With Water Rights (title conditional) ..	7,000.00	
		<u>8,734.50</u>

EIGHTEENTH ANNUAL REPORT.

CHEYENNE WELLS SUB-STATION.

160 Acres of land (title conditional).....	800.00	
Fencing	110.80	
3,000 ft. gal. Iron Pipe in ground.....	30.00	
Dwelling House & Barn.....	750.00	
		<hr/>
		1,690.80
(U. P. Ry. Property at Station \$18.)		
Total		<hr/>
		\$20,760.93

EXCHANGES.

BOOKS, PAMPHLETS, SCIENTIFIC PROCEEDINGS, ETC., 1905.

Argentine Republic:

- Anales del Museo Nacional de Buenos Aires.
- Anales del Ministerio de Agricultura.
- Boletín de Agricultura y Ganadería.
- Boletín del Ministerio de Agricultura.
- Camera Mercantil.
- Coal, Petroleum and Water in Argentine.
- Cotton Cultivation.
- Cronica Agricola.
- El Cultivo del Trigo.
- Immigration Statistics from 1857 to 1903.
- Index Explicatif des Objects Exposés par le Ministère des Travaux Publics.
- Los Hongos Parasitos de la Langosta. J. Kunckel D'Herculais.
- Le Surra Americain ou Mal de Caderas. Fdederic Sivori et Emmanuel Lecler.
- Memoria Presentada al Honorable Congreso. Dr. Wenceslao Escalante.
- Monthly Bulletin Municipal Statistics of the City of Buenos Ayres.
- Official Report of Mines, Mining, Metallurgy and Mining Laws of Argentine Republic.
- Section of Statistic and Rural Economy.
- Project for improving the Navigability of the River Uruguay, Between the River Plate and Concordia.
- Sketch of the Argentine Republic as a Country for Immigration.

Australia:

- Annual Report Bureau Sugar Experiment Station, Queensland.
- Department of Agriculture of Victoria, bulletins.
- Journal of Agriculture of Victoria.
- Annual Report Live Stock Association.

Canada:

- Annual Report Bee Keepers' Association.
- Annual Report Dairymen's Association.
- Annual Report Entomological Society.
- Annual Report Farmers' Institutes.
- Annual Report Fruit Growers' Association.

Canada:

- Department of Agriculture, Ontario, Bulletins & Reports.
- Department of Agriculture, Ottawa, Bulletins & Reports.
- First Annual Meeting Canadian Seed Growers' Association.
- First Annual Meeting Canadian Stock Breeders.
- Northwest Territory College & Experiment Station Bulletins & Reports.
- Ontario Bureau of Industries. Crop Bulletins.
- Ontario Fairs and Exhibitions.
- Report School of Horticulture of Nova Scotia.

England:

- Journal Royal Horticultural Society, London.
- Report Fifth International Conference of Sheep Breeders.
- Report Injurious Insects and Other Animals. Walter E. Collinge, Birmingham.

Finland:

- Skadeinsekters Upotradande I Finland.

Germany:

- J. Bolle. Bericht uber de Tatkigkeit der K. K. Lindeochemischen Versuchsstation in Gorz, 1902.
- J. Bolle. Der Seidenbau in Japan.

Dr. C. Brick. Bericht über die Tätigkeit der Abteilung für Pflanzenschutz.

O. V. Czadek und Dr. K. Kornauth. Ueberfadenziehendes Brot. Eisenaufnahme von Spinat.

Dr. Ludwig Hecke. Beizversuche gegen Hirsebrand Ueber das Auftreten von *Plasmopara cubensis* in Oesterreich.

Die Rostkrankheiten unfeyer Sonder-Abruck aus den Berichten der Deutschen Botanischen Gesellschaft.

Dr. C. Parrot. Verhandlungen der Ornithologischen Gesellschaft in Bayern, 1903.

Prof. Dr. Baessler. Bericht über die Tätigkeit der Agrikulturchemischen Versuchs und Samenkontrollstation in Koslin.

Prof. Dr. Baessler. Kartoffel-Anbau und Dungungs-Versuche.

Dr. A. Voigt. Bericht über die Tätigkeit der Abteilung für Samenkontrolle. Hamburg.

India:

Irrigation Administration Report of the United Provinces, 1903.

Jamaica:

Bulletins of the Department of Agriculture

Japan:

Prof. Chujiro Sasaki—A New Field Mouse in Japan. On Wax Producing Coccid, *Ericerus pe-la* Westwood. Some Observations on *Antheraea* (*Bombyx*) *Yamamai* G. M. and the Methods of Its Rearing in Japan.

Imperial Agricultural Experiment Station; San Jose' Scale, Abstract of Bulletin 30, About Some Injurious Insects.

Mexico:

Boletín Meteorológico. Toluca.

Netherlands:

Prof. Dr. J. R. Bos. Tijdschrift over Plantenziekten.

New South Wales:

Agricultural Gazette, Sydney.

Botanical Gardens and Domains.

New Zealand:

Annual Report Department of Agriculture.

Chemical Report—B. C. Aston, Wellington, N. Z.

Peru:

Boletín del Ministerio de Fomento, Lima.

Sociedad Geográfica de Lima.

Russia:

Journal für Experimentelle Landwirtschaft.

South Africa:

Fourth Annual Report of Government Entomologist, Natal.

The Transvaal Agricultural Journal.

The Transvaal Annual Report Department of Agriculture.

The Statistical Year Book, Colony of Natal, 1902.

Scotland:

West of Scotland Agricultural College Report.

Wales:

Lledwigan Farm Publications.

University College Publications, Bangor.

United States:

American Philosophical Society, Philadelphia, Pa.

Annals Observatory of Harvard College.

Bulletin of Agriculture, Raleigh, N. C.

Clarkson Bulletin, School of Technology.

Chemical Factor in Human Progress—Dr. Peter Austen.

California Fruit Growers' Convention.

Dunn County School of Agriculture, Menomine, Wis.
 Elisha Mitchell Scientific Society Journal.
 Food for Plants—Wm. S. Meyers, N. Y.
 Forest Fires in the Adirondacks in 1903.—H. M. Suter.
 Florida Monthly Bulletin.
 Geological Survey of N. J. Report for 1903.
 Geological Survey of Louisiana, 1899.
 Iowa State Horticultural Society.
 Journal Franklin Institute, Philadelphia.
 Lloyd Library, Cincinnati, Ohio.
 Minnesota Plant Diseases.
 Missouri Botanical Gardens.
 Marathon County School of Agriculture, Wis.
 Maryland Agricultural College Quarterly.
 Nebraska Irrigation, 1901-02.
 New Jersey State Board of Health Report, 1904.
 New York Museum Bulletins.
 New York Botanical Garden Bulletins.
 Nut Grower, Poulan, Ga.
 Pennsylvania Forestry, 1903-04.
 Proceedings Iowa Park and Forestry Association.
 Public Library, Providence, R. I.
 Report Oregon Board of Horticulture, 1905.
 Report Oregon Railroad and Navigation Company.
 Rochester Academy of Science.
 Report State Board of Health of Maine.
 Report State Chemist of Florida.
 State Board of Agriculture, Topeka, Kan.
 State Board of Agriculture, Newark, Del.
 State Board of Agriculture, Raleigh, N. C.
 State Board of Agriculture, Richmond, Va.
 State Food Commissioner's Report, Ill.
 State Board of Health, Augusta, Maine.
 State Horticultural Society, Kansas.
 State Horticultural Society, Massachusetts.
 South California Academy of Science.
 St. Louis Academy of Science.
 Tuskegee Normal and Industrial Institute.
 Utilization of Waste.—Dr. Peter T. Austen.
 University of Tennessee Record.
 Wilson Bird Bulletin, Oberlin, Ohio.
 Wisconsin State Horticultural Society Bulletins.
 Weather Bureau:
 Nebraska Section.
 Illinois Section.
 Colorado Section.
 New Mexico Section.
 Minnesota Section.
 Oregon Section.
 Wyoming Section.

SCIENTIFIC PERIODICALS.

Insect World, Gifu, Japan.
 Kongl. Landtbrusk-Adademien Handlinger och Tidskrift, Stockholm, Sweden.
 Le Naturaliste Canadien, Chicoutimi, Quebec, Canada.

AGRICULTURAL JOURNALS.

Agricultural Advertising, Chicago.
 Agricultural Experiments, Minneapolis, Minn.
 Agricultural Epitomist, Spencer, Ind.

American Hay and Feed Journal, N. Y.
American Fertilizer, Philadelphia.
Acker's Gartenbau-Zeitung, Milwaukee, Wis.
Beet Sugar Gazette, Chicago.
Breeder's Gazette, Chicago.
Chicago Live Stock World, Chicago.
Colman's Rural World, St. Louis, Mo.
Daily Drovers Journal, Chicago.
Dairy and Produce Review, San Francisco.
Dakota Farmer, Aberdeen, S. D.
El Agricultor Mexicano, C. Juarez, Mexico.
Elgin Dairy Report, Elgin, Ill.
Farm Stock Journal, Rochester, N. Y.
Farmers' Guide, Huntington, Ind.
Farmers' Review, Chicago.
Farmers' Tribune, Sioux City, Ia.
Farmers' Advance, Chicago.
Farmers' Advocate, London, Ont., Can.
Farm, Stock and Home, Minneapolis, Minn.
Farm and Live Stock Journal, Detroit, Mich.
Farm Visitor, St. Louis, Mo.
Farm Life, Chicago.
Flour and Feed, Waukegan, Ill.
Furrow, Moline, Ill.
Homestead, Des Moines, Ia.
Indiana Farmer, Indianapolis, Ind.
Kimball's Dairy Farmer, Waterloo, Ia.
Kansas Farmer, Topeka, Kan.
Live Stock and Dairy Journal, Fresno, Cal.
Metropolitan and Rural Home, New York City.
Mark Lane Express, London, Eng.
Modern Farmer, St. Joseph, Mo.
Missouri Agricultural College Farmer, Columbia, Mo.
Modern Miller, St. Louis, Mo.
National Farmer and Stockgrower, St. Louis, Mo.
National Farmer, Winona, Minn.
National Stockman and Farmer, Chicago.
Nebraska Farmer, Omaha, Neb.
Orange Judd Farmer, Chicago.
Ohio Farmer, Cleveland, Ohio.
Prairie Farmer, Chicago.
Practical Fruit Grower, Springfield, Mo.
Pacific Fruit World, San Francisco, Cal.
Rural New Yorker, New York City.
Reliable Poultry Journal, Quincy, Ill.
Rural Advocate, Battle Creek, Mich.
Southwestern Farmer and Breeder, No. Forth Worth, Texas.
Successful Poultry Journal, Chicago.
Southern Agriculturist, Nashville, Tenn.
Station, Farm and Dairy, Sydney, N. S. W.
Sugar Beet, Philadelphia, Pa.
Southern Fruit Grower, Chattanooga, Tenn.
Southern Farm Magazine, Baltimore, Md.
Successful Farming, Des Moines, Ia.
Southern Planter, Richmond, Va.
Texas Farmer, Dallas, Texas.
Up-to-Date Farming, Indianapolis, Ind.
West Virginia Farm Review, Charleston, W. Va.
Wallace's Farmer, Des Moines, Ia.
Western Fruit Grower, St. Joseph, Mo.

GENERAL NEWSPAPERS.

Colorado Springs Gazette, Colorado Springs, Colo.
Golden Globe, Golden, Colorado.
Holly News, Holly, Colo.
Montrose Press, Montrose, Colo.
Pueblo Chieftain, Pueblo, Colo.
Republic, St. Louis, Mo.
Salt Lake Herald, Salt Lake City, Utah.
Sun, The, Baltimore, Md.
Prowers County News, Lamar, Colo.

REPORT OF THE AGRICULTURIST.

The work accomplished has not been as great in extent or value as hoped. The work in the Agronomy Section has been in the direct charge of Professor W. H. Olin, who with his assistant, Mr. Danielson, have accomplished wonders with the funds available. As you are aware, Professor Griffith severed his connection with this Department in June of the present year to engage in ranch work. Prof. J. A. McLean has been selected to fill this position and take charge of work in the animal husbandry department. Mr. Danielson has notified me that he will sever his connection with the College and Experiment Station some time during December of this year. He has spent five years in this Department developing hardy grains in the San Luis Valley and in some sugar beet investigations in this district, and will prepare a report covering his work for the time he has been engaged in it. Professor McLean, in view of the fact that he has only been with us about three months, will have no report this year.

Work Accomplished. In the past year, the experiment to determine the feeding value of sugar beet pulp and alfalfa hay in fattening range steers has been completed and the results tabulated and discussed in Bulletin No. 102. The results of this experiment were decidedly satisfactory and I believe will be of great benefit to the feeders in general, particularly in the vicinity of the sugar factories in this State. The conclusions drawn from the results of the work may be briefly summarized as follows:

1. A two-year-old steer will make a gain of one and one-half pounds per day on alfalfa hay alone and will require approximately twenty-eight pounds of hay to make one pound of gain. The addition of ground corn to the ration of alfalfa hay will increase the market price of the steer and will add to the profit of the feeding venture if corn can be procured anywhere below 90 cents per hundred pounds. A pound of corn is equal in feeding value to 2.8 pounds of alfalfa hay and nine pounds of beet pulp for fattening two-year-old steers.

2. 3.22 pounds of beet pulp is equivalent to one pound of alfalfa hay when fed in conjunction with hay to two-year-old steers.

3. With alfalfa hay at \$5 per ton, it will pay to feed ground corn with hay to fatten the steers, provided the corn can be purchased below 90 cents per hundred pounds.

4. With alfalfa hay at \$5 per ton, sugar beet pulp is worth \$1.50 per ton to combine with corn for fattening steers.

The Horse Breeding Experiment. The co-operative experiment with the U. S. Department of Agriculture in the production of American Carriage horses has been successfully inaugurated. Nineteen brood mares and one stallion have been secured and are now on the College farm. Five of these mares were in foal when purchased and the foals have been successfully reared and have recently been weaned from their dams. All of the mares have been bred to Carmon and as far as present indications can determine, all of them with one exception are safe in foal. These mares have been kept in the mountain pasture since last May. Last spring, the barbed wire fence surrounding this pasture was removed and a woven wire fence of the most approved pattern was erected surrounding the entire pasture. In all, 1,600 rods of this woven wire fence was erected by the College the wire being furnished by the Department of Agriculture.

Plans and specifications have been prepared for a suitable horse barn, stables and sheds for the proper conduct of this experiment. The bids will probably be opened and the contract let within the next ten days and the building erected in time to care for the stock during the inclement weather of the coming winter. Fifty tons of choice upland hay have been purchased by the Department of Agriculture for the feeding of these horses during the winter months, and bids have been asked for the supplying of 1,000 bushels of oats, which we hope will be sufficient to carry the horses through the coming year. Corrals have been planned in connection with the barn and stable to be erected on the new farm purchased from Mr. Andrews for the experiment work.

Plans for Future Work in Animal Husbandry. Owing to the liberality of the last legislaturer, sufficient funds are available for the carrying on during the coming year of some valuable work in the live stock department of the Station. A large portion of the funds, however, will have to be used in erecting suitable buildings and sheds for the horse breeding experiment and the steer feeding work contemplated. We have planned to carry on some feeding experiments with hogs to determine the feeding value of sugar beets for fattening young hogs and also for wintering brood sows. We feel that this is an important work to be undertaken in this State at the present time.

A line of work has also been planned which will be used as a demonstration as much as an experiment. This is to determine the advisability of giving liberal feed, care and shelter to range calves and yearling steers during the winter months. Our plan as outlined, is to secure sixty steer calves as soon as they are weaned

from their dams, this month. We plan to secure these from different parts of the State so as to have the work as fully representative of the various sections as possible. Fifteen of these calves will be from the western slope, thirty from the foothills of the eastern slope and fifteen from the ranges of the Eastern Plains. These calves will be branded when selected and twenty of them will be brought to the College farm at once, five from the western slope, five from the lot on the eastern plains, and ten from the foothills of the eastern slope and the remainder will be wintered under the conditions followed in the sections where they are now being ranged. One year later, twenty more head will be selected and brought to the College farm and one year after that, the remaining twenty head will be brought to the farm here. The calves brought to the farm this fall will be used in experimental feeding when good care will be given them and they will receive sufficient feed to keep them growing and in a thrifty condition. During the summer months they will be given the run of a good pasture and will be compared with the second lot of twenty, which will come to the College farm next fall. Both of these lots will have good feed while on experiment and will be kept in a growing and thrifty condition and both lots will have good pasturage on the range the succeeding summer. The remaining twenty head will be brought to the farm two years from this fall. All will be marketed together in the following spring and a comparison made of the carcasses of representative steers from each lot to determine the difference in quality of meat, etc. Careful records will be kept of the prices paid for the steers in the different lots together with the expense of bringing them through the experiment so that an accurate estimate may be made as to the profits which may be derived from the different systems of maintaining steer calves from birth until marketed.

We have outlined a small experiment with twenty head of calves to be brought to the farm this fall. One-half of these will be given a ration composed of grain, alfalfa, hay and roots. The other half will be given grain and hay.

For the next summer we have planned nothing very definite, but will do some work in the growing of soiling crops for dairy cows.

In the Agronomy section extensive plans have been outlined and as Professor Olin expects to take the matter up very fully in his report, it will not be necessary for a discussion of these plans at this time.

The College and Station farm is, I believe, improved in condition and with the addition of the 67 acres recently purchased by the Board, we are very hopeful that some excellent work will be

accomplished that will be of great benefit to the agricultural interests of the State.

There is a great field of investigation in sugar beet growing and also with alfalfa. I am sure that a much improved type of alfalfa may be secured by a proper system of selection and we are planning to engage somewhat extensively in investigations with this end in view during the coming year. We are also very hopeful of the success of Macaroni or Durum wheat for the farmers of eastern Colorado. The results of the present season have been very encouraging and the fact that this crop can be grown under very adverse conditions means much to the farmers on the Plains. Our work in the Agronomy section for the past year has been very largely in investigating the conditions in the various sections of the State. In the future, however, we hope to confine our work as much as possible to the Station farm and not spread too much over the whole State. While there are very urgent demands coming from all sections, yet I believe that we can accomplish a much greater permanent good to all concerned by undertaking more definite lines of investigation and carrying them through for a term of years under the most rigid inspection so that when we secure results there may be no question as to their accuracy. While a certain amount of good is to be accomplished by co-operative work, yet it is not of a character which can always be depended upon for absolute reliability.

Very respectfully submitted,

W. L. CARLYLE,
Agriculturist.

SUB-SECTION OF AGRONOMY.

OUTLINE OF WORK PLANNED.

The following outline shows the scope of the work planned:

1. Field Nursery Work.
2. Test of Variety Types of Grains and Forage Plants.
3. Co-operative Field Work in Different Sections of the State.
4. Sugar Beet Investigation Work.
5. Compiling Data Obtained for Station Use.

Field Nursery Work. Early in the year I arranged the work so Mr. A. H. Danielson, my assistant in this section, could complete his investigations and breeding work with various grains. I therefore placed the field nursery work under his charge, with the exception of work with corn and alfalfa.

In the field nursery Mr. Danielson has sought by cross breeding and seed selection to develop a beardless drouth resistant type of wheat for the plains, a rust resistant type of spring wheat for our irrigated lands, a hardy and early maturing spring wheat for our higher altitudes, a hardy early maturing type of oats for the higher altitudes of the State, a desirable and hardy winter wheat, a more desirable type of emmer than is now obtainable, a superior stock beet, native beet seed, and a hardy soy bean. He has given this work his close attention and I have asked him to make a concluding report to you showing results obtained.

I have had charge of the other lines of investigation work.

The value of the field nursery work is apparent when we consider that here we study the heredity and prepotent power of individual plants. Here the initial work is done which gives us vital seed stock, especially important in a State like Colorado with such varying climatic conditions. Each seed stock which comes from the field nursery must show adaptability, producing capacity and superior quality. When these elements are maintained under field conditions we shall hear no further complaint of "seed running out," failure to mature, and low yields. I believe the work in our field nursery should bring out better seed stock, adapted to our particular conditions of plant growth.

CORN.

When I came to the Station in July, 1904, Prof. Paddock turned over to me the work with a particular strain of corn he

was studying. This was an eight rowed dent corn brought into this State by Mr. Swadley from West Virginia some thirty years ago. It has shown itself adapted to our seasons and has been known to mature a crop of corn as high as 6,000 feet elevation. The seed selected for crop of 1904 had a majority of eight rowed ears and a few ten rowed ears. My work with this corn shall be to improve its physical characteristics and increase the number of rows of kernels to the ear—thereby increasing its producing capacity. While corn is a minor crop in Colorado, still there are certain localities raising corn that will continue to grow this crop for some years to come. If they can grow a better type of corn yielding fifteen to twenty-five per cent. more than they now can obtain, it will be of considerable importance to them. Corn can not be grown with profit on high priced land. Unless one can make a ten per cent. profit on his capital invested, his crop is not a profitable one. Mr. R. V. Pickett of Edgewater, Colorado, is carrying on co-operative work with me on this corn breeding work.

ALFALFA.

Alfalfa is the greatest forage crop grown in the State. I find such a variation in character of plants in field, cultural methods and quality of hay that I have decided to carry on some plant selection work in alfalfa with different cultural treatment. Mr. Philo K. Blinn at Rockyford has taken up an experiment with me in the study of individual plants of alfalfa. The plants for study were seeded this spring in rows two feet apart each way. The alfalfa made a good growth this season and nearly every one blossomed and set seed. Remarkable differences were observed as to character and amount of foliage and number of seed pods borne by different plants. These points of difference were tabulated and these mother plants made units of seed selection. Those having the most desirable foliage, bearing the largest amount of vital seed, will be propagated, with the idea of developing and fixing that particular strain. It is my plan to continue this alfalfa nursery just started at Rockyford and to start one on the College grounds this coming season with the view of studying plant differences, cultural methods and seed production.

Test of Variety Types of Grain and Forage Plants. To determine the varieties of grain best adapted for our conditions, we decided to grow, in tenth acre plots, the very best types of wheat, oats and barley which we could procure. These were seeded under as nearly uniform conditions as possible on the field south of Agricultural Hall. The barleys selected were:

1. Hanna—The best two-rowed barley of Germany.
2. Hanchlon—A desirable two-rowed barley of Sweden.

3. Princess—A superior two-rowed barley carefully bred in Sweden and imported by Prof. D. G. Fairchild, Agricultural Explorer of the U. S. Department of Agriculture.
4. U. S. No. 7584—This is a barley imported from Africa and claimed to have been grown on alkali lands near the Sahara Desert.
5. Ideal Hullless—A beardless six-rowed barley developed by Mr. Danielson.
6. Minnesota No. 105—A vigorous high yielding barley developed at the Minnesota Experiment Station.
7. Oderbrucher—A barley (six-rowed) obtained from Wisconsin. This barley has been developed for its high protein content, often running as high as 15 per cent. protein where average barley runs 9 to 11 per cent.
8. U. S. No. 12023—A barley obtained from the Department of Agriculture as a vigorous two-rowed barley.
9. U. S. No. 12709—A barley obtained from the Department of Agriculture as a very sturdy type of bald barley.

These plats were all seeded the same day—March 28th. The ground upon which these varieties of barley were seeded had been in alfalfa for several years and gave a remarkably good growth of straw. A heavy wind and rain storm July 8th caused all the varieties but Minn. No. 105 and Oderbrucher to lodge badly, only about ten per cent. of these two plats went down. U. S. No. 12023 barley lodged very badly, nearly 90 per cent. of it being blown down. The harvest yields were as follows:

Name.	Bushels.	Lbs. Per Bu.
1. Hanna	35.4	52.2
2. Hanchion	59.6	51.0
3. Princess	41.6	48.0
4. U. S. 7584	42.4	48.6
5. Ideal Hullless	36.0	63.0
6. Minn. 105	45.2	49.7
7. Oderbrucher	28.6	51.0
8. U. S. 12023	53.4	51.0
9. U. S. 12709	42.7	62.5
(Hullless).		

It will be observed that the Hanchion and U. S. No. 12023—two rowed barleys—gave an increased yield over the other seven types in the test. The two bald barleys—Ideal Hullness and U. S. No. 12709—show a lessened yield, but we must remember that these thresh out like wheat without the hull and, like wheat, are measured on the basis of 60 pounds to the bushel while the other types of barley, with the hull, are measured on the basis of 48 pounds to the bushel.

This experiment was conducted on alfalfa sod encouraging a rank growth of straw and a tendency to lodge.

The quality of the U. S. 12023 was exceptionally fine and its sturdy growth shows it to be a desirable type of barley. Just before the plots began to ripen the field gave the finest showing of barley that I ever saw. I shall test these types side by side another year in our experimental fields, under uniform conditions.

The varieties of wheat seeded were as follows:

1. Colorado No. 45.—A type of wheat developed by Mr. Danielson for Colorado conditions.
2. Colorado No. 50—A type of wheat developed by Mr. Danielson for the higher altitudes.
3. Arcada Wheat—A soft white wheat being grown in San Miguel County for milling purposes.
4. Kansas No. 201 Wheat—A Durum wheat being grown at Hays, Kansas.
5. Kansas No. 203 Wheat—A Durum wheat being grown at Hays, Kansas.
6. Kansas No. 206 Wheat—A Durum wheat being grown at Hays, Kansas.
7. Egyptian or Seven Headed Wheat—A wheat believed in many parts of the State to be a superior wheat of high yielding power.
8. Minnesota No. 169—A hard spring wheat which has proven to be a superior wheat in the Northwest; this was developed at the Minnesota Experiment Station.
9. Minnesota No. 292—A hard spring wheat developed at the Minnesota Experiment Station which has shown good qualities previous seasons in Colorado.
10. Minnesota No. 181—A hard spring wheat developed at the Minnesota Experiment Station which has shown good qualities previous seasons at this Station.
11. Blue Stem Wheat—A wheat which has proven of worth in eastern Oregon.
12. Polish Wheat—One that at other stations has shown great vigor but low yielding power; not a milling type and grown this season for a comparative study with other wheats.
13. Sonora—One of the wheats which has been grown for many years in Colorado.
14. Kubanka Durum Wheat—A type which other stations have found superior in point of yield and milling quality to all other types of Durum.
15. Black Don Durum Wheat—A type now being grown in some non-irrigated sections of our State.
16. Defiance—One of the very best types of Colorado spring wheat.

In connection with these plats we arranged a series of plats testing effect of different periods for seeding spring wheat, a tenth acre plot of Kubanka Durum and a tenth acre plot of Defiance were seeded on the last Saturday of January, February, March, April, May and June. All the varieties of wheat made a good growth, the season being a very favorable one and the ground alfalfa sod, fall plowed.

Storms caused much of the grain to lodge, the Sonora wheat lodging quite badly. It was also seriously attacked by rust. Rains were so seasonable that none of the wheat was irrigated until June 26th. Only one irrigation was given the wheat. The wheat varieties were seeded March 29-31. The first varieties to ripen were Colorado No. 45 and Colorado No. 50. The latter was in medium dough July 26th and fully ripe August 4th. Colorado No. 45 was a few days later. Minnesota No. 169 was the last to ripen, the grain being only in the milk when above named varieties were in the dough state. It was not ripe for full ten days after Colorado No. 50 was harvested. The plats testing different periods of seeding showed very little difference in growing period for the January and February seedings. The Kubanka seeding for March

ripened ten days before Defiance seeded at same time. The latter seeding of Defiance was attacked by rust and did not stool as well as the earlier seeding. The June seeding was to show the effect on stooling of grain and how it is subjected to rust and insect attacks when seeded quite late. It was a total failure as a grain crop and was cut for hay.

The Kubanka wheat seeded in April and May was not seriously injured by rust but the Defiance seeded in April and May suffered injury from rust.

The harvest report for wheat varieties is here given:

Name.	Bushels Per Acre.	Weight Per Bu.
1. Colo. No. 45	34.9	60.6
2. Colo. No. 50	29.9	61.0
3. Arcada	21.5	54.5
4. Kans. No. 201	43.0	64.2
5. Kans. No. 203	38.0	64.0
6. Kans. No. 206	31.9	64.2
7. Egyptian	27.2	60.0
8. Minn. No. 169	33.1	58.7
9. Minn. No. 292	41.9	60.0
10. Minn. No. 181	35.2	58.3
11. Blue Stem	40.1	58.2
12. Polish Wheat	41.6	60.1
13. Sonora	40.0	63.1
14. Kubanka 5639	42.8	65.9
15. Black Don	38.5	65.5
16. Defiance	28.3	54.1

The Defiance lodged very badly before it was fully ripe, which lessened its yield and reduced the quality of its grain. This was also true with Arcada and Minn. No. 169. While Sonora lodged badly, yet it did not seem to reduce the quality or quantity of its grain seriously. Rust attacked Sonora more severely than any other grain.

SEEDINGS AT DIFFERENT PERIODS.

Date.	Kubanka Durum, Yield,		Defiance, Yield,	
	bu. per acre.	lbs. per bu.	bu. per acre.	lbs. per bu.
Jan. 28.....	36.1	62.9	53.7	60.9
Feb. 25.....	28.9	62.3	48.0	60.5
Mar. 25.....	41.7	62.7	40.1	57.5
Apr. 29.....	41.6	62.6	30.9	55.2
May 27.....	21.3	59.0	9.5	47.0
June 24.....	4.95	49.0	Cut for hay	

The quality of the June seeded Defiance was so inferior that it was cut for hay. The experiment indicates that wheat seeded in May and June will ripen but give yields which are below profitable production and grain of inferior quality. The earlier seedings would seem to show the better results but further experiments are necessary to determine the best month for spring seeding of wheat. The quality of the grain from the January and February seedings

was superior to the quality of the threshed grain from the other seedings.

VARIETIES OF OATS.

1. Colorado No. 13.—This is a selection of New Market Oats grown at a high altitude last year; these oats were imported from the Dalmeny Estate, Scotland, by Mr. Eugene Grubb, three years ago.
2. Kansas No. 2.—These oats were grown at Hays, Kansas, last season. This was one of the two best yielding varieties grown, commonly called the Kherson Oats.
3. Kansas No. 4.—Grown at Hays, Kansas, last season; one of two best yielding varieties, commonly called the Texas Red Rust Proof.
4. U. S. No. 12303.—This is an early maturing type of oats imported from Russia by Prof. M. A. Carleton; it is commonly known as Sixty Day Oat.
5. Colorado No. 5.—A type of oats developed from the Field Nursery by Mr. Danielson.
6. Colorado No. 9.—A type of oats developed from the Field Nursery by Mr. Danielson.
7. Wisconsin No. 4.—The best variety out of a test of forty different types of oats tested at the Wisconsin Experiment Station. This is a special seed selection from the Swedish Select Oat imported by Prof. M. A. Carleton.
8. Early Champion.—The best early oat in a four year test at the Iowa Experiment Station. Developed by Mr. Frank Fowler of Ames, Iowa.
9. North Finnish Black.—A superior yielding and good quality black oat imported by Prof. Carleton.
10. White Russian.—The standard white oat of Colorado.

These oats were seeded March 31st on ground adjacent to the wheat and barley plats. The growing period showed marked differences. Early Champion and U. S. No. 12303 ripened earliest and showed a finer straw than other varieties. Colorado No. 5 and Colorado No. 9 were matured within a very few days of Early Champion. All four varieties were cut July 31st. In growing habit Colorado No. 13 and Wisconsin No. 4 closely resembled each other. They showed the same sturdy straw, wide, deep green leaf and large well filled panicles. Both ripened the same time, August 7th.

The last variety to ripen was the White Russian. It was the last variety to head out and was just in the milk when the first oats were cut. The harvest yields follow:

	Name.	Bushels.	Lbs. Per Bu.
1.	Colo. No. 13.....	92.4	41.2
2.	Kans. No. 2.....	92.8	39.0
3.	Kans. No. 4	78.2	40.0
4.	U. S. No. 12303.....	81.8	38.0
5.	Colo. No. 5.....	81.6	47.0
6.	Colo. No. 9.....	77.0	45.8
7.	Wis. No. 4.....	84.4	40.6
8.	Early Champion	80.9	39.5
9.	North Finnish (Black)..	80.7	40.0
10.	White Russian	93.1	38.7

MILLING WHEAT INVESTIGATIONS.

While testing varieties of wheat for yield and general quality we must not lose sight of the fact that good milling wheat is desired by our millers.

To determine what types our millers prefer a circular letter was addressed to the millers of the State asking them to name the best spring wheat and best winter wheat for milling purposes, grown in Colorado. The almost universal reply was, for spring wheat, *Defiance*, and for winter wheat, *Turkey Red*. When I sought to aid farmers to obtain good seed stock of each I found it impossible to get pure *Defiance* or *Turkey Red* seed wheat. Mr. Danielson found this last spring that he had a small amount of *Defiance* wheat which he had increased from a single wheat plant in his Field Nursery. This seeded an increase plot equal to one-quarter acre in area. The wheat obtained this year will be used for a larger seed plot next year and in this way develop a sufficient quantity for distribution in the irrigated sections of the State growing a spring wheat.

By correspondence I found that Mr. S. C. Bassett, Secretary of the State Board of Agriculture of Nebraska, had a very fine strain of *Turkey Red* winter wheat. I secured 100 bushels of this wheat, sending 50 bushels to the Arkansas Valley for distribution and holding 50 bushels for distribution in northern Colorado.

I obtained 15 bushels of the best strain of *Kharkov* wheat from the Kansas substation at Hays and seeded it on sod on Mr. H. P. Miller's ranch southwest of Fort Collins. Mr. Miller purchased 25 bushels of the Bassett *Turkey Red* so we can compare the value of these desirable types of hard winter milling wheats. Since *Durum* wheat was tested on the plains of the State a few years ago, with a fair degree of success, I deemed it advisable to continue this experiment to definitely determine in what section of the non-irrigated regions it can be successfully grown one season with another. Further investigation seemed necessary to ascertain the milling quality of Colorado grown *Durum*. Millers of the State were loth to test it, believing this wheat has no merit, and farmers should be discouraged from growing it. Mr. B. F. Hottel of Fort Collins last fall decided to purchase for milling purposes 1,500 bushels of *Durum* wheat. He ground this and permitted Mr. Danielson and myself to direct experiments with this flour. It was tested in pastry, biscuits and raised bread by many of the College people and citizens of the town. More than forty experienced bread makers of Fort Collins testified that bread made of this *Durum* flour had an excellent flavor, good texture and volume. In fact they agreed that *Durum* flour has good baking

qualities. This preliminary test was quite satisfactory and warranted making a State test of Durum wheat. Kubanka having been proven the best Durum wheat for milling purposes at the North and South Dakota Stations, I determined if possible to get seed Kubanka of known government importation which had been kept pure and true to type. I found 4,000 pounds out near the east line of the State, crop of 1903, which U. S. Cerealist M. A. Carleton pronounced genuine, a sample sent to him being the best he had received at Washington.

I found 10,000 pounds which could be traced back to this College and from there to Prof. Carleton's importation. This gave us 14,000 pounds of genuine Kubanka which was sent in amounts varying from 10 to 100 pounds per farmer in 30 of the 59 counties of the State.

On the 1st day of May each farmer receiving this wheat was asked to report on the nature of soil where wheat was sown, date of seeding, amount of seed per acre and character of stand.

On July 1st I asked these co-operators to report climatic and crop conditions.

On September 1st a circular was sent out calling for a report on data of maturing wheat, prevalence of rust, presence of foreign grain (oats, barley or other kind of wheat) in the plat sown to Kubanka, more or less than the usual amount of rain this past crop season, yield and sample of grain when threshed. Not all these reports have come in but when received I desire to issue a progress bulletin on the season's results.

To thoroughly answer all objections to Kubanka Durum as a milling wheat I am now conducting tests on a commercial scale. Two millers are now purchasing this wheat for milling, and I am in hopes that all millers located near the regions where this wheat is being grown will soon be willing to convert it into flour so these farmers can make this positive gain by growing their own bread, and thereby add many hundred acres to the wheat area of the State.

Another question to be settled while millers of the State decline to purchase this wheat, is a market for that not needed for seed purposes. I have corresponded with the leading grain merchants and commission men of Salt Lake City, Omaha, Kansas City, Cincinnati, Chicago and Minneapolis. I find there is a strong market for good No. 1 Durum for export. The market question is settled for this year and I am satisfied we can find a market for all the Durum we can grow even if millers of Colorado do not use it. I desire to continue the field test two more seasons, keeping in close touch with farmers growing this wheat, so I may discover the regions best adapted to Durum wheat culture. I trust in this

way we can encourage seeding those types of milling wheat which give best returns to both the farmer and the miller.

I am discouraging all attempts to grow Durum wheat on the irrigated lands, since I am convinced from personal study and observation that irrigating this wheat causes it to deteriorate.

On account of the live stock interests of Colorado, forage crops are of special importance. In the San Luis valley where field peas furnish the principal forage we continued an experiment testing various types of field peas for both forage and grain. Canada White, Canada Green, White Marrowfat, Black eyed Marrowfat, Garbanzo Peas and Golden Vine were this year tested. The experiment has been on Mr. L. B. Sylvester's farm for two years. Last year the Canada Green and Marrowfat gave the best results in yield of grain. This season's crop is not yet threshed. When results are tabulated I desire to publish same in crop report bulletin.

Proso, a drouth resistant millet, has given very good results in many localities where it has been tested west of the Missouri river. I am this year testing this millet for Colorado conditions. I find the red proso much earlier and yields more grain than the white, although the latter has a sturdier growth and yields more forage. I shall make a field test of these drouth resistant millets next year.

CO-OPERATIVE FIELD WORK IN DIFFERENT SECTIONS OF THE STATE

(a.) *North Park.* Cattle raising has been the chief occupation of the North Park citizens for many years. Prices for the last few years have cut down the profits in the business, causing many of these people to investigate the possibility of doing some crop farming in the Park. Last year oats, wheat and barley were grown in some sections of the Park with a fair degree of success.

At the request of these North Park people we carried on some preliminary experiments with ranchmen, testing oats, barley, various grain, root and forage crops which seemed adapted to high altitudes. At Walden, and on Mr. Barney Mallom's ranch, these various experiments were placed in plot form. The work with the experimental plots was done by Mr. Glynn Stannard, a post graduate student in Agriculture. The people of the Park furnished Mr. Stannard ground for the two experimental series of crops, and team and buggy to visit the various co-operators in the Park. You will remember you allowed me to use \$200 of the experiment fund to pay Mr. Stannard for time employed, with the understanding that incidental expenses would be kept to the minimum. The money apportioned was not sufficient for Mr. Stannard to carry the experiments through to completion. Mr. Will Mosman of Walden told Mr. Mallom he would report results to me, but I have

not been able as yet to get harvest data from the experiments. The last report from Mr. Stannard showed :

1st. That many experiments were seriously interfered with by rabbits and gophers. One crop farmer had 20 acres of his crop destroyed by rabbits and gophers ;

2nd. That proso, a drouth resistant and early maturing millet, was too easily affected by frost. It is a failure at high altitudes ;

3d. Both red and alsike clover do fairly well, but the first season are liable to be choked out by weeds ;

4th. Turnips, rutabagas and sugar beets, and mangels, made a satisfactory growth ;

5th. Early maturing oats and bald barley made a satisfactory growth and were headed out July 20th to 26th, being seeded from May 15th to May 31st ;

6th. Field peas did well when irrigated. Seeded May 15th to 30th, were 15 inches high July 25th and just in bloom. I am satisfied when the crop can be irrigated it will be a paying one in North Park.

7th. Mr. E. C. Lee of Hebron has had good success this season with winter wheat, winter rye and emmer. He seeded winter wheat and winter oats July 18th this season.

8th. The success of Mr. Lee and the good showing made by others with winter grains led me to send enough hardy winter barley and winter wheat to seed five acres each, to Mr. Stannard. These he gave to five of his most careful co-operators and they seeded the grain early in August.

9th. These preliminary experiments should be made the basis for definite experimental work with grain, root and forage crops in North Park. The people want to grow supplemental feeds for their stock so they can send their cattle to market as long twos or short threes, instead of long threes or short fours, as they have heretofore done. With better market facilities they have encouragement to engage in mixed farming to at least a limited extent.

The State is so large, climatic and soil conditions vary so much, that we need to carry on experimental work in many sections of Colorado to determine the crops and the particular variety of these crops most profitable for each section.

I think our policy should be to do that work which will be productive of the greatest good to the greatest number of citizens. This I believe can best be accomplished by (a.) taking one section at a time and making a thorough crop inspection of that particular region.

(b.) Co-operative work with farmers testing Durum wheat in various portions of the State, which has been mentioned previously.

(c.) *Field Peas in San Luis Valley.* This has been an ex-

periment to determine the best varieties for grain and forage for the valley conditions. It has been carried on with Mr. L. B. Sylvester, as mentioned above.

(d.) Experiments with alfalfa and early maturing types of dent corn. These experiments were taken up with Mr. P. K. Blinn, Station Field Agent at Rockyford. The corn was selected by Prof. C. P. Hartley in charge of the corn breeding work of the U. S. Department of Agriculture. He selected early maturing types of corn for this experiment. The worms attacked the corn at earing time and made it practically impossible to get any yield tests from the experiment. We were not even able to obtain a satisfactory quality of seed for the succeeding year. We have several corn counties in the state and I hope we can take up some work with them as soon as our crop regional investigations shall have been completed.

The alfalfa work at Rockyford has been to study seed production and forage producing strains of alfalfa, as referred to on a previous page. Alfalfa is our most important forage plant. It has been grown for forage in various countries for centuries. I find that great differences are to be observed in different alfalfa plants. With the County High School students of Montrose, I counted fourteen different kinds of alfalfa plants in one hour's study of an alfalfa field. By the study of individual plants, I believe it possible for us to select a type of plant which shall improve the quality and increase the quantity of alfalfa forage obtained from a given area.

My primary aim is to breed up a type of alfalfa adapted to our conditions, find out and encourage successful methods of seed production and study cultural methods which shall prove beneficial to crop production. I have long desired to carry out this work. At the Iowa Station I did just enough of this work to show me great possibilities in it. I now wish to make alfalfa study an important part of our Station work.

(e.) *Crop Investigation Work.* This past year I have tried to acquaint myself with crop conditions in the various sections of the State. I have visited and studied the crops in nearly all counties of the State where crop farming is being carried on. I think this will be of considerable value as it has made me familiar with the prevailing conditions in these sections so I can intelligently co-operate with farmers and ranchmen, in crop investigation work, later on. My purpose is to encourage the improvement of quality of crops grown through careful selection and interest the boys and girls in this work through the "Colorado Seed Competition," spoken of in another portion of this report. When we get well adapted and acclimated types of crops of superior quality, we want to hold

them for the farmers of tomorrow to derive the profits on same. I trust that interesting the boys and girls of today in seed selection will enable us to do so. Our conditions are favorable for seed production for other states. It will add another source of revenue and show the possibilities in our grains, forage and roots.

SUGAR BEET INVESTIGATION WORK.

(a.) In co-operation with the U. S. Department of Agriculture, Mr. Danielson has carried on some very interesting and important investigations relative to seed production. He has just completed a three year investigation of commercial fertilizers for beets. I have asked him to report upon both of these. He has carefully compiled the data for Station use.

(b.) To determine the best types of beets for our conditions, we have begun a test of those varieties which have proven most desirable in different sections of the beet region of this country, as well as Austria, France and Germany. Since this work has but just been started, we have no data for publication.

(c.) We have planned for an experiment testing the effect of constant cropping of beets upon the soil.

(d.) We have an experiment testing different cultural methods with sugar beets. From the same seed in similar soil, seeded at the same time, one Arkansas valley farmer obtained eight tons while his neighbor just across the road obtained thirty tons per acre of beets this past season. It is our purpose to try to find the cause for these differences that we may aid the beet farmer to make this new industry still more profitable.

(e.) Testing the feasibility of using Colorado-grown seed. It is believed that our soil and sun puts sugar into the beet. The Station has used home-grown seed for two years and the indications are that a higher sugar content is made possible by using home grown seed. We wish to make a thorough demonstration of this, before publishing any data.

(f.) To learn through correspondence the methods of culture practiced by our best sugar beet growers and, through press bulletins, to give all sugar beet growers the benefit of their experience, and successful methods.

COMPILING DATA FOR STATION USE.

(a.) *Bulletin on the Thorough Tillage System.* To meet a growing demand for some facts bearing upon the principles of semi-arid farming, bulletin 103 was compiled. It was written to show that the character of the soil, amount of rainfall, careful seed selection of such crops as show drouth resistant power, of known market value, thorough and careful tillage of the ground

must be considered in farming ventures on lands where irrigation cannot be practiced. Not all unoccupied land is good farming land and this bulletin seeks to show that the total area of land which can be successfully farmed within our state "above the ditch" is yet to be determined.

It is believed that a conservative statement of the facts already found out by the experiment stations in the semi-arid regions of our Nation, together with an explanation of the principles of thorough tillage, may prevent later disaster to men of small capital who might otherwise attempt farming operations where crop production could not be made profitable.

It is to be hoped that our next legislature will be able to furnish money for the operating of State Demonstration Farms in these lands, similar to the plan now being successfully operated in Utah.

(b.) *Crop Statistics.* We need to have some system for obtaining reliable crop data in Colorado. The daily newspapers of Denver have, in compiling their crop statistics, sought assistance from me and after diligent search was forced to confess I was unable to furnish anything but an estimate. I believe that we can compile this data and, if the expense account can be met, I am willing to undertake the task of gathering this statistical crop data for State and Station use.

While the year just closing has been a busy one, I have most thoroughly enjoyed the work and trust that, through your guidance, the counsel of Dean W. L. Carlyle, and the efficient help of my assistant, we can make the work of the Agronomy Section of growing interest and value to the Agriculture of Colorado.

W. H. OLIN,
Agronomist.

Dec. 1, 1905.

REPORT OF THE CHEMIST.

To The Director:

The work of the Chemical Section has been continued on the lines given in previous reports. The results of our digestion experiments with sheep to determine the coefficients of digestion of timothy hay, upland hay, alfalfa hay, corn fodder, sorghum fodder and hay made of the salt bush (*Atriplex Argentea*) have been presented, in part, in bulletin No. 93.

There is another section of this study which I hope to present in the near future. The work on this has been completed, or will be within a short time, debarring subsidiary questions which may still arise, and may be deemed of sufficient importance to solve by further chemical study. I do not now know of any reason why I should not report the work forming the basis of this bulletin as practically completed.

This bulletin will be on the lines of study presented in bulletin 39, and will consider the coefficients of digestibility of the various extracts, alcoholic, aqueous, including both the cold and hot water, etc. I have in this study endeavored to determine the amounts of the various sugars, starches, gums, pentosans, the hemicellulosee, the portion attacked and brought into solution by the action of chlorin and sodic hydrate, and the true celluloses, together with their respective coefficients of digestibility.

The character of this work is very far from that of a popular bulletin, but is a work which I hope will contribute something material to our knowledge of the composition of fodders in general, which despite the large amount of work that has been done on this subject, and the still larger amount that has been written, is very unsatisfactory.

The work which we have done can only be presented as a further attempt to contribute a little to the subject. This little may be very small but we have done the best that we have been able to do, and while I know that there are certain weaknesses in our work which it would be easy to point out, both in regard to things which we have not done, and also in regard to the manner in which we have done others, we shall be content to present it as it is, wholly our own errors, weaknesses and merits, if there be any.

In bulletin 99 we presented our views on the means at the disposal of the Colorado ranchman with which to maintain the fertility of our soil. There may be questions to present to him con-

cerning which longer proclamations may be made, but there is none of more vital importance within the province of my department, or as I believe, of any other. I have of late noticed some very misleading statements relative to this subject, which tend to do great injury by leading ranchmen into the belief that the crops now coming to be generally grown, particularly sugar beets, do not make the heavy drain upon the soil's fertility, that they have been led to believe to be the case. Bulletin 99 is in this respect timely and fortunate. All of the data on which this bulletin is based are facts, ascertained by our study of Colorado conditions, and apply to the lands of our ranchmen.

I would again urge upon you for consideration, the question of the waters of the San Luis valley, of which we began to make a study some years ago. We did quite an amount of work on this subject, studying its broader features. The results of that work have never been presented for the reason that it is incomplete and much of the analytical work was done on samples which were entirely too small and should be done over again. We should certainly make a new study of some of the artesian wells, but more particularly of the waters of the Rio Grande. I am aware that a representative of the U. S. Geological Survey spent at least one summer in the valley making a study of its waters. I have not as yet seen the publication of his results, but I would scarcely expect our study to cover the same phases of the question that he would consider. I know that a study has been made, but I do not know its scope, though I was in correspondence with Dr. Siebertahl, the representative of the Survey.

This study would mean quite an expense to the Station, perhaps, but it is surely worth completing. I would not predict that it would lead to the recognition of new facts, but many of those already obtained relating to the changes in the waters used for irrigation would be greatly strengthened by duplication, for as yet there is no great mass of observed facts pertaining to this subject.

During the past year I have done but little or nothing, pertaining to the subject of alkali in Colorado. This has been partly due to my failure to obtain certain material, the study of which I hoped might throw important light upon the subject as it is presented in this State, partly too, because we have already made our views upon the practical points of this subject to our farmers known both by lectures and by publications on the subject; partly also, because there is a large portion of our people who have already accepted the views that we hold on this subject.

The subject is still an interesting one and really of no less importance than it has been heretofore, though the people have

come to pay less worthy attention to it and have begun to alleviate the conditions producing it by draining their lands.

The work on the methods of extracting bees wax has been for the most part repeated this summer, and is nearly completed. We found it necessary to do this in order to bring it up to date, and to establish our results. Unfortunately we have not yet found time to complete it and write up the notes. This work has been wholly in the hands of Mr. Alford, whose other duties take up the whole of his time, leaving none which he can devote to this work, which fact I regret exceedingly.

The study of the changes which barn yard manure undergoes under our conditions, the loss in nitrogen and organic matter, in short its rate of deterioration, has been continued. Very much analytical work awaits us in connection with this subject, in fact we have only made a fair beginning on this study.

There is some material on hand pertaining to the composition of our native grasses. A beginning was made on this study several years ago, and a number of them—34—were collected and analyzed, but owing to changes in our working force, this work has never been completed. This material might perhaps be collected and presented either by itself or with other material as a bulletin. This subject, it is true, has been presented in a bulletin by this Station, but when this work was begun we had it in mind to make a much more extended study than the one already published, but as it is, it might be well to do something with this material as it includes our most important pasture and hay making grasses.

In addition to the lines of work already presented, we have done a small amount of unclassified work among which is some for the Section of Agronomy on the composition of wheats and flours. I mention this because I think it may prove to be a line of investigation worthy of considerable study. Still I am aware that such studies have been made by other stations, and it is possible that we would only repeat their experiments to arrive at their conclusions, which are already supported by a sufficient mass of concordant results. I believe, however, that it would be well to pursue this line of investigation far enough, to prove that our wheats and flours are fairly represented by results already obtained, when it would be quite proper to drop the chemical side of the investigation.

The amount of miscellaneous work required by the Section during the last year has been very large. I am aware, and greatly appreciate the fact that both the Director of the Station and the President of the College, have been very considerate in this matter, still the number of requests that have come to the department

has been sufficient to have kept the whole force of the department busy for the greater part of the year had we undertaken to comply with them. While I am willing to give such information as I can on the variety of subjects presented, and while I think that there are some instances in which we can properly grant the requests for work, I believe that by far the greater number of requests are made without any appreciation of the nature of the request. In some instances persons making requests are very reasonable, in others they are not. The requests have ranged from the most trivial subjects to important topical investigations which were strictly personal matters and likely to involve us in local factional strife and lawsuits, with which it would, in my opinion, be very impolitic for us to have anything to do.

Respectfully submitted,

WM. P. HEADDEN,

Chemist.

Fort Collins, Colorado, November 15, 1905.

REPORT OF THE ENTOMOLOGIST.

To The Director:

Sir: I have the honor to make the following report from the Entomological Section of the Agricultural Experiment Station, for the year 1905.

Referring to the schedule adopted for the year's work I might say that I have not deviated much from the schedule there given.

The usual amount of work has been done collecting and rearing insects to determine their habits and Colorado fauna. Many notes have been recorded upon economic species and numerous illustrations have been made by Miss Palmer in ink that will be of service in later publications.

The caterpillars that did so much injury to sugar beets in Colorado last year appeared in some of the beet-growing sections early in the summer but they have not attracted attention since. It seems to be a fair inference that their parasites, which were noticed in considerable numbers in the fields early in the season, succeeded in keeping their numbers down.

Mr. Johnson has continued his studies upon the Potato Flea-beetles but they too have been much less numerous this year so that he was unable to make satisfactory tests of field spraying as a remedy. He wishes to continue the investigation another year.

Mr. Johnson has also given some attention to the Woolly Aphis during the year but wishes to continue the work another year before publishing his results. The Black Peach-aphis was very destructive again this year to the fruit of peach trees that were laid down about Canon City but I have had no opportunity to test any methods for their destruction or control.

As I was unable to secure the co-operation of the ranchmen in Routt in carrying out experiments for the control of the Western or "Mormon" Cricket, no work was taken up with this insect. Its ravages have been reported less severe than in 1904, although their area of infestation has extended.

The experiments to determine the value of spray mixtures for the destruction of the Cottony Maple Scale have been closed and resulted successfully.

That part of the work which was being carried on in the Apiary conjointly with the Department of Horticulture and Botany have been concluded, the results being negative and indicating that

the germs of pear and apple blight do not live over winter in honey in the bee-hive.

The work of collecting bees and other insects at the flowers of apple and pear trees for the purpose of learning their possible relation to the spread of blight received considerable attention during the time fruit trees were in bloom, and I wish to continue the work in 1906.

A more exhaustive and detailed report upon the injurious insects of the year can be put in shape for publication if it is thought best.

Early in the year it seemed that an unusual number of insect depredations were reported but few of the species were as numerous in later broods so that, as a whole, 1905 has not been much above the average for insect losses in Colorado. Grasshoppers have been more injurious and the Codling Moth has infested a larger percentage of apples than for two or three years previous.

The office of this section has been removed to new and better quarters and an additional room has been provided for use as an insectary.

Respectfully submitted,

C. P. GILLETTE,
Entomologist.

REPORT OF THE HORTICULTURIST AND BOTANIST

To The Director:

The experiments with commercial fertilizers with potatoes, mentioned in my last report, have been continued through the present season in co-operation with Mr. E. R. Bliss, Greeley, Colorado. These tests were in acre plots on the second crop of potatoes. The first crop followed alfalfa sod. Last year our results showed a slight increase in yield in favor of bone meal. This season nitrate of soda gave slightly the best returns. While the second crop is not so good as the first we must conclude as the result of these experiments that the lessened yield is not due to a lack of plant food. We shall consider there experiments concluded so far as they relate to this particular kind of soil and crop rotation.

VARIETY TESTS WITH POTATOES.

Our tests this year include nearly fifty foreign varieties sent to us by the Department of Agriculture. The purpose of all of our variety tests with potatoes is to find if possible some kind which will be better adapted to our conditions than any we now have. Should any of these kinds show any decided tendency to resist disease and the effects of our peculiar conditions they will form the basis for breeding a potato suited to our needs.

FORESTRY EXPERIMENTS.

Last season we purchased six thousand seedling catalpa speciosa and six thousand seedling black locust trees and planted them in nursery rows on the college grounds. These trees are to be distributed next season among twenty farmers in as many representative localities in the State. The purpose of this experiment is to demonstrate the feasibility of growing forest trees for utility purposes and to encourage such plantings. In some parts of the State posts are already very scarce and ten years from now, when these plantations are to be turned over to the farmers for their use they should be very valuable. And in the meantime we expect that these experiments will do a great deal of good by bringing the subject before the people. The whole subject of forestry is one with which this State is peculiarly and vitally interested.

APPLE ROT.

In my last report mention was made of a new apple rot

caused by an undescribed species of *Altenaria*. Our studies with this disease have now progressed far enough to warrant the publication of a bulletin on the subject, the manuscript for which is now nearly completed. The same fungus was found this season rotting pears and also attacking pear leaves.

PRUNING.

The manuscript for a bulletin on pruning is about ready for publication.

PLANT DISEASES OF THE YEAR.

Root-rot of apple and pear. This disease occurs in all of the orchard sections and appears to be slowly on the increase. Beyond the fact that the trees die but little is known of the disease.

GRAPE MILDEW.

This disease was found quite abundant on varieties of the vinifera grape in two different localities the past season. It is due to the attacks of a parasitic fungus commonly known as the Powdery mildew of the grape *Uncinula Spiralis*. The fungus attacks all young growing parts of the plant and when severe causes the affected parts to shrivel and die. Its presence is first indicated by a whitish moldy growth on the surface of the affected parts soon followed by a powdery appearance due to the immense number of spores which are formed. Brownish discolorations of the tissues affected then appear while more or less stunting and distortion of parts follow. While the disease is often quite abundant in some vineyards it does not appear to be doing serious damage as yet.

MILDEW OF THE PEACH.

A great deal of this disease was found in one peach orchard early in September of this year. It is due to a fungus parasite, *Sphaertheca pannosa*, which forms a white felt-like growth on the surface of young leaves. In many cases too it had spread on to the twigs of recent growth and was also found to some extent on the fruit. In the latter case it is capable of doing some damage as the flesh of the affected spots becomes hardened and accompanied by an abnormal outgrowth of fuzz.

YELLOW S OF RED RASPBERRY.

Attention was called to the yellows of the Marlboro red raspberry in one locality where it was stated to be quite general. The same trouble was also observed in another region, where the plantation was situated on low ground in which the water level was not far from the surface. This is evidently the same disease that

is killing out the Marlboro variety in New York and briefly described by Stewart in Geneva Experiment Station Bulletin. The underground portions of affected plants are found to be discolored as well as a portion of the canes above the surface of the soil, and at the point where the brown and green portions join a slight constriction occurs. The tissues of the inner bark were found to be invaded by the hyphae of a fungus, which it is now believed will prove to be the cause of this trouble.

ASPARAGUS RUST.

This disease is surely gaining a foothold in this State and threatens serious reduction to an otherwise paying truck crop. It was reported this year from two localities at two different plantations. In one of these Resin Bordeaux mixture was tried but under conditions which did not favor very definite results. Sulphur was also used on a small portion of the same plantation but without any effect in checking the disease. The disease is a true rust like those of the cereals and possesses the three forms of the fungus. Further efforts in checking the ravages of this parasite will be made next season.

TOMATO BLIGHT, BACTERIAL.

A blight of the tomato of bacterial origin was noted in a number of localities during the past season. The plants first show signs of attack by wilting. This is due to the fact that the roots are so affected by the parasitic organism as to fail in supplying water to the rest of the plant. Fields when once infected are liable to give rise to the same trouble year after year, which fact indicates the necessity for crop rotation. The disease is often held over, too, in the soil of the seed bed unless care is taken in renewing it after the trouble appears.

BLIGHT OF EGG PLANT.

A blight of egg plant also of bacterial origin was reported during the season from one locality where a large area blighted last year. It is capable of doing much damage and attempts to prevent its occurrence should be the same as those of the bacterial blight of the tomato.

STRAWBERRY LEAF BLIGHT.

This is a fungous disease which produces a spotting of the foliage of the plants after which they die prematurely. It was reported from two localities and seems to be most serious on low poorly drained soils.

RHIZOCTONIA OF SUGAR BEET.

During the past season the rotting of sugar beets due to this fungus has been noted in a number of localities. In some cases it affects the lower end of the root, in others the crown is found so badly diseased that the leaves are nearly all eaten off at the base. The root itself is usually blackened wherever affected and eventually decays. The disease manifests its presence first by the wilting and dying of the leaves, although this may take place quite slowly. In fields where the disease occurred the year before it is found to be worse the next, although cases were noted in which the trouble appeared in fields planted for the first time to beets. The parasite is a soil fungus and is apt to be most destructive under conditions unfavorable to the best growth of the plants.

Respectfully submitted,
W. PADDOCK.

REPORT OF THE IRRIGATION ENGINEER.

To The Director:

During the year 1905, the work of the section of Irrigation Engineering and Meteorology has been along the lines hitherto taken up. During the spring and much of the summer, the head of the section was absent for most of the time in connection with the work in protecting the agricultural interests of the State against an attack made on it by our neighboring state and this call was largely based upon previous investigations of the Experiment Station.

During this time, the work, as outlined, was carried on by Mr. Trimble. The line consisted principally of observations and records, in extension of previous work and which now practically completes some of the work that has been in progress for a series of years, and has required the accumulation of records of a number of years in order to be valuable. A great part of the work of reduction and of digestion of records is still to be done. This series of records have largely been a development of the plan of work outlined in 1890-91, and published in the report in the outlines of those years.

In brief, there were two general lines of work outlined; one, the investigation of the amount and application of water, including the determination of the amount applied, the amount absorbed in the soil and the amount of run-off. The second general line was an irrigation survey of the State. The latter was planned to be extensive in character; to take up the valleys of the State one by one with a study of the special problems and special investigation as might be called forth by conditions as they developed. The seepage investigations, which have proved to be much more extensive than anticipated, the studies in evaporation, the studies in duty of water, were all parts of this general line.

For a number of years we had available but a small sum of money, usually less than two hundred dollars, so that the hopelessness of the completion of the general line was evident, and when that appeared, the general plan was not published from year to year, although it still formed the basis of our work. With the money available it was necessary to take up such special problems as did not require the expenditure of money. While these subjects were not such as would have been chosen with free choice, they were of such type as it was necessary to choose and the re-

sults showed that they were of great importance. The problems that could be chosen, if free choice were available, might include such as were of immediate value to the individual farmer, or those, which while not of immediate value, yet ordinary foresight would indicate were of great importance to the State. The former, as a class, required apparatus, an expenditure beyond our reach. The latter, by the co-operation of various canal companies, and utilization of means furnished by other people, required the least expenditure of money, and with those which were selected those studies have led to the publication of a number of bulletins which have received considerable attention and have resulted in additional studies wherein the field work is essentially complete. These include seepage, additional seepage measurement now available, records of a number of thousands of miles of measurement, additional investigation of forestry and its relation to snow, given in extension in Bulletin 55. Studies for the irrigation survey of the San Luis Valley, Poudre Valley and Arkansas Valley are of such a degree of advancement that their completion is evident in the near future. Some of these investigations developed of such importance in their application to the broader questions of the State and protection of the whole irrigated agriculture of the State that it seemed best, when the interests of the State were considered, that there should not be premature publication and hence these have been held back so far as they relate to the Arkansas and San Luis Valleys, in both of which there have been, or are, serious attacks upon irrigation and consequently, upon the agriculture of the region. It seemed far better to withhold the results until they could be supported by a mass of data than to make premature publication. These investigations, made with the help and cordial co-operation of the Board have been the basis of the defense by the State in the attack by Kansas, and were also the means of preventing a serious direct decision against Colorado in the Elephant-Butte case. The reasons, which actuated the retention in the former valley are no longer operative, and these results will probably be issued in the near future.

During the past two years the work as State Engineer came very largely as a development of the work of the Station and while causing interference with many phases of the work has not been without its advantages, in the fact that some lines could be developed and made helpful to the investigations of the Station. This was especially so in the studies of forestry in relation to snow-fall and as important factors in the preservation of the water supply for the agriculture of the State, besides many important irrigation inquiries. Previous investigations which resulted in bulletin 55 had shown the desirability of much further winter in-

vestigation at high altitudes. The expense was, however, beyond the reach of the Station, or seemed to be. Through some available funds of the State Engineer's office, and the necessity for similar investigation in connection with the Kansas case, it was made possible, with a small expenditure from the Station, to develop a large amount of unique data along this line.

Mr. Mills made a circuit throughout the mountains of the State at high altitudes, at great personal risk, and for a sum exceedingly small, when the risks are considered, and obtained a mass of data and a set of photographs that is remarkable in its character and excellence. This is supplemented by similar photographs taken through the aid of Mr. Decker at the head waters of the Laramie, of the Poudre, and of the Grand. This requires working up, and a portion is issued by the State Engineer in so far as valuable for the work at that office. When the trip was made, by the addition of the expense of photographs, etc., a large part of the work is available for a more complete investigation and will supplement bulletin 55, and has formed the basis of a conviction regarding the usefulness of forests to the agricultures of the State.

With a further development of conditions and additional aid that was provided this fall, I hope that we may take up the further investigations along the line as planned in 1891, and develop the series of studies and bulletins along the line of the irrigation survey of the State and the further study of the relation of plant life to water. This latter requires instruments in order that the investigations will be of real advancement. It is very easy to imagine tests of importance which, while they may be interesting and curious, are of really no advance in addition to the knowledge that we have. It is largely the waste of money to do what has hitherto been done. But there is, however, an opportunity to real advancement along these lines and it is hoped that we shall be able to take this up.

The studies in Meteorology have followed the same lines that have been carried on for a series of years. The general purpose of these records, in addition to giving ordinary meteorological records, has been to put upon record and give data to make a study of that date important to plant life, and which might be termed agricultural meteorology. This includes, especially, those elements relating to moisture, further study of rainfall, of evaporation, of the amount of moisture in the air. We now have one of the longest series of records, so that the United States Weather Bureau has made special request that I prepare a report and summary of the records of evaporation, of which there are none to compare with ours in length and uniformity of character. We also have a unique series of records of solar radiation for the

intensity of energy and heat which comes from the sun, and which is the final cause of the growth of plants. These elements, which we have especially studied are not taken to any extent by the Weather Bureau, whose function is principally to forecast the weather, and not to study the climate or agricultural meteorology. The series of records now includes some eighteen years continuous record. There is much labor and a constant surveillance of the records, but the greater part of the work comes in the collation and study of the records after they are taken. Clearness in presentation is only the result of the labor of many unsuccessful trials.

Respectfully submitted,

L. G. CARPENTER.

REPORT OF THE VETERINARIAN.

To The Director:

My work in connection with the Experiment Station dates from June 1, 1904, and has been directed largely along the line of investigation of poisonous plants, on the range, and their effect upon live stock, with special reference to loco and larkspur.

Early in the spring an agreement was entered into between the Director and the U. S. Department of Agriculture, whereby we were to share the expense, as well as any credit that might result in a co-operative investigation of these weeds, and their effect upon live stock. This work, on the loco investigation, has been under the more immediate direction of Dr. C. D. Marsh of the Department of Agriculture. I have in accordance with our agreement aided him in every way possible, by counsel and by directing the post mortems.

Together we have visited various sections of the State studying loco weeds and the conditions relative to their supposed injurious effects upon live stock.

The work with larkspur has been under our charge, and directed by me. The Department at Washington has assisted in identification of plants, determining their toxicity, and etc.

LOCO.

Satisfactory arrangements were made in April for two pastures, one-half mile south of Hugo, in which to carry on the work during the season. We were especially fortunate in securing these pastures in such close proximity to the railroad and a good town, and further in this respect, the one being by a few hours work, made entirely free from loco weeds and furnishing most excellent pasture on the creek bottom. The other, adjoining is was as badly infested with white loco as any we had seen, and purple loco was in abundance. On the ranch was a cottage which conveniently furnished Dr. Marsh with living rooms and laboratory. On May 5th, the last of the live stock was shipped to Hugo. Six yearling and six 2-year-old steers were purchased at the Stock Yards in Denver, they having come from the vicinity of Greeley and raised on farms free from loco weeds.

Seven horses were also purchased at the Stock Yards and came from a non-locoed section in Utah. Eight horses were secured at Fort Collins, seven coming from a pasture four miles

west of town and one from a pasture south of town. These animals were all with the exception of the one from south of Fort Collins, in very poor condition. This was deemed no objection as we wished to conform as nearly as possible to actual range conditions in every particular.

The horses and cattle, upon arrival at Hugo, were divided as nearly equally as possible into two lots. Six steers, (three yearlings, and three 2-year-olds) with seven horses (one having died) were placed in the locoed pasture, and the remainder in the non-locoed pasture to serve as a check.

The animals that were placed in the pasture free from loco weeds have continued to thrive throughout the season, and are in good condition now. Disease and misfortune have been the lot of the others until now they are all gone.

This, it seems is the experience of ranchers who try raising cattle, horses, or sheep and use ranges infested with the loco weed. They do not all become locoed, but succumb to different maladies, which animals in a thriving condition would otherwise easily escape.

METHODS ADOPTED WITH ANIMALS ON LOCOED PASTURES.

The season of 1905 has been disadvantageous because of the unusual precipitation early in the spring, and the frequent showers throughout the summer months.

The stock were placed on the pastures late in April and the last of them on May 5th. The grass was already well started and for three weeks they were watched carefully, and were seen to persistently avoid the loco weeds.

At this time, one horse and one steer were placed in the corral and fed exclusively on white loco, (rattle weed, *Astragalus mollissimus*). They partook of it reluctantly at first, but within two days were eating it freely. At the end of one week, it was noticed that they were becoming very weak and for fear that they would get down in their enfeebled condition, they were turned back on the pasture. They returned to grass, and were seldom seen to touch either the white or purple loco.

This experiment was repeated several times, with the same animals and then with others but always with the same results—they would not acquire the habit of eating loco weeds, but at all times preferred the grass which by this time was luxuriant.

This one thing became very noticeable, however, that on an enforced loco weed diet they immediately began to show unmistakable symptoms of starvation and became very weak. All the animals in this pasture, because of being taken up at intervals and placed on exclusive diet of the weeds and possibly from a partial ration of the plants in the pasture, were not thriving as were the stock in the non-infested pasture.

By the 23d day of July, the grass became very short, while the loco weeds from not having been molested, were green and very tempting. At this time, one 2-year-old steer was seen to be eating largely of white loco. One week from this time he had developed typical loco symptoms, according to experienced stockmen.

A careful post mortem was held. From this time on, one steer after another was seen to be eating largely of the white loco, and the symptoms would as surely develop a little later.

WHITE LOCO PREFERRED.

At this point it may be well to note the fact that when both purple and white loco were placed before either horses or cattle, they would invariably eat of the latter.

The white variety largely predominated but certain places in the pasture the other was in abundance, but our observation so far point to the probability that the white is much preferred by them.

The claim is made by many of the most reliable stockmen, that while the white variety is more generally eaten, the purple is much more to be feared.

CATTLE FURNISHED BEST SUBJECTS.

While the horses remained poor and weak, they did not develop typical cases of locoism and invariably the most satisfactory results were secured in cattle.

Two horses died in August of acute glanders. Two became so weak from eating the weed that they got down and died without developing characteristic symptoms.

The two dying of glanders, did not interfere greatly with our plans as there was but one left in this pasture, the others not having been exposed.

The steers having succumbed one by one, in the infested pasture and it not being deemed advisable to purchase more so late in the season, two steers were taken from the control pasture, and placed on the loco diet early in September, and in three weeks were seen to be eating of the weed and losing in condition. At this date they are showing unmistakable symptoms of locoism and, while they may not now succumb from the disease, they will never survive the winter under range conditions.

POST MORTEMS.

Not only were the experiment animals carefully dissected, but we visited various places in the eastern portion of the State wherever diseased animals could be found and held careful autopsies.

The brain, nerve roots, and spinal cord were carefully preserved for future histological study, extracts were made and forwarded to Washington. Also large quantities of the plants and different media cultures from the body cavities.

The results of the autopsies will be given only in a general way for the reason that the uniformity of results do not warrant a detailed account of each particular case. They are interesting only because of the uniform negative results obtained.

The macroscopic examination of both the living animal and the internal organs in our numerous autopsies have aided us only in eliminating quite a number of foolish theories loudly proclaimed by over confident theorists.

As the investigation is not completed, I do not feel warranted in drawing any conclusions, or expressing my opinion regarding the probable outcome of any phase of the loco problem.

The work has progressed much more satisfactorily than we had hoped for. It has unfolded new facts and conditions at every step which have been wrought with great interest and we feel encouraged that in the end at least, some of the hidden mysteries surrounding this perplexing problem may be unraveled.

The results of the investigations so far have attracted our attention to the following:

1. Locoism is a specific condition and is associated with at least one species of plant, *Astragalus mollisimus*.

2. Horses and cattle prefer grass and eat but sparingly of the weed as long as grass can be had in quantity to satisfy hunger.

3. The white loco plant has an extremely low nutritive value.

4. There are no uniform pathogenic lesions, post mortem or anti mortem.

5. Parasites are found in no greater quantity than in other emaciated animals. No unusual parasite has been found and no one parasite is uniformly present.

6. The theories as to clot of blood or serum in the fourth ventricle of the brain; sand in the stomach; an excess of arachnoid fluid, have no foundation, in fact, according to the results of autopsies held up to date.

7. I believe a qualitative chemical analysis of the plant and of the contents of the stomach containing loco weeds is of the greatest importance.

8. There is no evidence as yet that stock will eat of loco weeds when grass is plentiful.

9. Several parasites live upon the loco weeds and in some places have devastated large areas of the plant.

10. Considering the immense loss to the live stock industry from the ravages of these plants the economic possibility of ex-

terminating them by the grubbing hoe is worthy of serious consideration.

LARKSPUR.

There can be no question but that several species of larkspur growing native in the mountainous districts of Colorado are a greater source of loss to the stockmen than all other weeds combined, loco weeds alone excepted.

It has been estimated by Dr. E. V. Wilcox of Montana that the loss from poisonous plants in that State is greater than from all other causes and diseases taken together and not far from \$100,000 annually.

In Colorado we have at present no statistics whereby we can estimate with any degree of accuracy the aggregate mortality. Judging, however, from the loss reported in other states and reports received at this office from most every section of this State, I feel confident that \$40,000 from larkspur alone is a conservative estimate.

There are four species of larkspur found growing abundantly in the middle and western part of the State and one found growing sparingly in the eastern section.

Other species have been found in isolated places but have not been especially accused of doing any harm and their toxicity has not been proven. Named in the order of their abundance and the damage which they are reported to have occasioned, they are:

- Delphinium bicolor.
- Delphinium glaucum.
- Delphinium scopulrium.
- Delphinium azureum.
- Delphinium penardi.

In June a circular letter was addressed to several thousand stockmen in this State and a fairly liberal response was received. Of those, who replied, 93 per cent. had experienced loss from various poison weeds, ranging from one to sixty per cent. in different years. A very small proportion of those who had been losing heavily for years were satisfied with regard to the identity of the plants responsible. All kinds of harmless plants were sent to me, presuming them to be larkspur, or other deadly weeds.

Larkspur is confused with aconite; camas with wild onion; hemlock with wild parsnip, and perfectly harmless plants with those which are known to be toxic or at least suspicious. All agreed that larkspur was more dangerous in the early spring, and especially during or after a storm.

Twenty-five per cent. were sure that they died from bloat the same as from alfalfa. The remedies tried were as varied as they

were amusing. Tapping through the side and allowing the gas to escape from the rumen, was generally practised and bleeding in the tail or in the ear was recommended by seventy per cent. of the replies.

As soon as larkspur was four inches high, I began gathering it at intervals of two weeks and after drying for ten days, forwarded it to the Bureau of Plant Industry, Washington, for chemical analysis. The first was gathered on April 26th, and the last in full bloom on June 12th. The report sent me by Albert C. Crawford, pharmacologist, was as follows:

The method used in testing the physiological activity of plants was to weigh accurately 5 grams of the powdered plant, then extract this over night with 20 c. c. of water and 10 c. c. alcohol added mainly as a preservative. The following day the extraction with water and squeezing was continued until the fluid came colorless. The fluid was then evaporated to dryness in vacuo at about 40° C., and the residue made up to 30 c. c. with water. Any number of c. c. would do as well. The alcohol was given off in vacuo.

The First Batch Collected April 26, 1905.

1 c. c. injected into a guinea pig (subcutaneously), weight 730 grams. Caused no disturbance.

3 c. c. in guinea. No symptoms.

6 c. c. in same guinea. Killed.

6 c. c. injected into guinea pig, 285 grams. Killed in 33 minutes.

4 c. c. injected into guinea pig, 352 grams. No symptoms.

5 c. c. killed guinea pig weighing 196 grams. Died in 55 minutes.

4 c. c. injected into guinea pig, 299 grams. No symptoms.

Evidently lethal dose for this solution lay between four to five c. c.

Second Stage, Gathered May 16, 1905.

Solution corresponding to 4 c. c. of No. 1 caused no symptoms in guinea pig weighing 445 grams, while 5.3 c. c. killed one of 350 grams, but death was delayed longer than with extract of 1st stage.

Third Stage Gathered in June, 1905.

Solution corresponding to 4 c. c. caused no symptoms in guinea pig weighing 376 grams.

5.3 c. c. caused no symptoms in guinea pig weighing 500 grams.

6.6 c. c. caused no symptoms in guinea pig weighing 480 grams.

Evidently lethal dose is much higher and the plant loses much of its activity in development."

This report is very conclusive as showing that the plant contains an active poison and consequently, that animals do not die merely from bloat. It is also interesting in that the results substantiate the claims of experienced observers that the plant loses its toxic properties as it approaches the flowering period. In my laboratory at the College, I fed rabbits and sheep on both dried and green larkspur. The detailed report will appear in a bulletin now being prepared. It will show that the fresh larkspur is much more toxic than the dried.

Rabbits lived for days on a spare dish of dried purple larkspur, but succumbed readily to the fresh. The tall larkspur *Del-*

phinium glaucum, gathered on the College campus and fed green, killed a rabbit weighing two pounds and one ounce, it having eaten seven and one-half grams. The symptoms were those occasioned by an overdose of a powerful sedative.

At first there was a brief period of excitement, in which the breathing was accelerated and the eyes had a glassy appearance. This was thirty minutes after eating the last of the weed. Fifteen minutes later, it was seen to be bloated and rolled over on its side. The breathing became very slow; the heart beats scarcely perceptible, and it became unconscious. A hypodermic injection of 1-100 gr. of glonoin was given and repeated in thirty minutes. No decided improvement resulted. One hour later, the bloat had disappeared, but otherwise symptoms had not improved. No other physiological antidote was tried. It remained in a comatose condition for twenty hours and died. This and similar experiments proved conclusively that the cause of death is in the main from the presence of an active poison which depresses the function of the involuntary nervous system.

There is reason to believe, however, that in many cases, especially with cattle and sheep that the bloat becomes so severe that death results directly from this cause.

OTHER ANTIDOTES TRIED.

Without going into detail at this time, I will state that experiments with potassium iodide and aluminum sulphate as recommended by Chestnut and Wilcox in their report on poison weeds of Montana have proven all that is claimed for them, as a chemical antidote. I have recommended it to our stockmen and have received some favorable reports from them. True it is that many cases occur on the range when the rider is not in attendance but at the same time, it is also true that poisoning more generally happens when they are being driven at time of round-up, or to and from the range. Poisoning more generally happens during the early spring time and especially during a storm and by guarding them more closely during the dangerous times and being ready with this antidote carried at all times in the saddle bags, I believe the loss can be greatly reduced.

Experiments with Atropia Sulphate, as a physiological antidote, have given very surprising results. After the poison has been absorbed into the system, and it is too late for a chemical antidote, the alkaloid of belladonna, is theoretically antagonistic, and practically promises us a satisfactory remedy. The fact that most stockmen keep a hypodermic syringe for vaccinating their cattle against blackleg and anthrax and are therefore, familiar with its use, make the administering of this antidote easily understood.

Atropine tablets ready for use can be secured at most any drug store and considering the size of dose are extremely cheap. From one-half to one grain according to size of animal is dissolved in teaspoonful of water and injected subcutaneously. It is physiologically antidotal to the toxic substance in the weed and in five minutes shows its beneficial results in the improved heart action. The improvement has been so marked in two or three instances tried experimentally on sheep and rabbits that the animal has gotten onto its feet within ten minutes and tried to run away.

While the report by Dr. Crawford on the plants sent to Washington, were extremely interesting in determining the physiological activity of the plants at different stages of growth, he failed to report the nature of the poison. This he promises to undertake later upon the receipt of larger quantities of the dried plants.

The several conclusions arrived at with reference to larkspur are as follows:

1. The larkspur, at least five species, contains a specific poison and does not kill by bloat like alfalfa as many have supposed.

2. The toxic principle of larkspur has not yet been determined.

3. The plant loses its poisonous qualities as it approaches the flowering season and finally becomes harmless.

4. Two species because of their abundance, are doing most of the damage, viz.: *Delphinium glaucum* and *Delphinium bicolor*.

5. The stockmen generally have little knowledge of the identity, poisonous nature, or satisfactory remedy for larkspur.

6. Considering the enormous loss and the fact that larkspur is usually found in circumscribed areas, it would seem feasible in many localities at least, to undertake its eradication by the grubbing hoe.

7. By avoiding the areas where larkspur abound during the months of April, May and June, the loss can be reduced to the minimum.

8. In potassium permanganate and atropia sulphate, respectively, we have a chemical and physiological antidote of real practical value. These drugs can be carried by the range riders and easily and quickly given.

The results in restoring badly poisoned sheep, rabbits, and cattle, by their use experimentally has been remarkably satisfactory.

OTHER POISONOUS WEEDS.

Besides the several species of loco and larkspur other poisonous weeds have received some attention.

From our present knowledge of the subject it appears that fully ninety-five per cent. of the total annual loss can be attributed

to several species of five different genera of plants, namely, loco, larkspur, camas, lupine and hemlock. It is estimated in the state of Montana that the annual loss from all poison weeds is not far from \$100,000 and more than the loss from all other causes of death by disease and accident combined. In this State, it must be nearly, or quite as great.

The study of poison weeds presents a complex and exceedingly difficult problem.

Some plants are poisonous at certain periods of their growth and not others. Certain parts may be deadly while others are comparatively inert, and the quantity of poison may vary in the same parts of the same species under different conditions.

The majority of these plants are not of sufficient importance commercially to have ever been studied chemically and the nature of this poison remains a mystery.

Some plants are not only perfectly harmless ordinarily but furnish a most desirable food, may under climatic and other influences suddenly become deadly. For example, the common potato when exposed to the sunlight develops an active principle called solonine and Kaffir corn under conditions of drouth and a backward season develops when eaten by cattle, the deadly poison, prussic acid.

Indeed, it has been shown conclusively, that the quantity of alkaloids in the foliage of cinchona leaves varies greatly between day and night and on cloudy and sunny days.

Whether it be true or not, that animals eat certain plants instinctively when sick, certain it is that instinct teaches them to avoid many dangerous plants when left entirely to themselves and not suffering from the ravages of hunger. It is a matter of common report that animals left to themselves for months on a badly infested range escape harm but as soon as they are driven in the round-up or to market they reach for weeds right and left that they otherwise would not touch and become poisoned.

Most plants as they approach the flowering period become coarse and unpalatable, or the foliage dries up and even though they may be equally as deadly are not so freely eaten.

The aconite or monk's hood is very deadly at all periods of its growth but seldom eaten because of its peculiar bitter taste, and the tingling sensation in the tongue.

There is one species of the rubber plant, *Ocotelea richardsonii*, which has caused extensive loss among sheep in Middle Park in the month of July. This plant according to report from Washington contains no poison but forms an indigestible rubbery mass in the stomach which proves fatal by obstructing the bowels.

The lupines grow abundantly in all of the mountainous re-

gions of this State. If eaten, when wet from dew in the morning or from rain or snow, will cause bloat the same as alfalfa or clover. Lupines are cut for hay in Montana and the danger comes from cutting it for hay after it has gone to seed. The poison appears to be confined to the seed, and produces a jaundiced condition, called lupinosis.

We have several species of the carrot family, which go without distinction as, wild parsnip. Here is a good example of the need of education among farmers and stockmen. The several species have a close resemblance in their characteristic umbrella shaped tops but differ greatly in their toxic properties. The poison, hemlock, (*Conium maculatum*) supposed to have been the death potion of Socrates, contains the alkaloid conine and while not as abundant as some of the others is far more deadly. It is found growing at high altitudes and in damp places.

The water hemlock, (*Cicuta maculata*) is the one, because of its abundance and deadly nature in doing the greatest harm. It grows along ditch banks and on the borders of alkali places. The tops are poisonous early in the season and the roots are extremely poisonous at all times.

The water parsnip (*Sium cicutae folium*) somewhat resembling the others is not poisonous. It grows abundantly on the Gunnison River, and its tributaries.

Wild parsnip (*Pastinaca sativa*) the common garden parsnip run wild, is seen growing along the river in Boulder and in many places in the State. It is generally supposed to have become poisonous in its wild state, but this is not true.

The death camas (*Zygadenus venenosus*) is a dangerous plant. It is not confined in its growth to "shallow depressions where there is slow seepage" but in this State is found growing quite luxuriantly on dry elevations. It has a bulb with a frail root stalk and hence, is not easily pulled from the ground. Because of its bulb it is often mistaken for wild onion and prairie lilly (Indian sego) both harmless plants.

The camas is very deadly but dries up early in June. Some disastrous cases of poisoning have been reported from this weed in the month of May. One man sent some of the plants to me for identification, claiming that it had killed ten milch cows for him inside of one hour.

The most important of something like seventy-five different poisonous plants reported, and not yet spoken of in this report, I will merely mention a few worthy of more especial consideration, and which should be made subjects for investigation in the future.

Swamp Camas. Ergot-and-smut.
 Several species of the spurge family, especially showy milkweeds.
 Swamp helleboe, (skunk cabbage).
 Night-shade.
 Potatoes, under certain condition.
 Kaffir corn and sorghum.
 Prairie fennels.
 Wild cherry—especially a scrubby species growing in the draws in
 the eastern part of State.
 Henbane.
 Oregon yew.
 Arnica.
 Anemone.
 False mallow.
 Sage brush.
 Wild geranium.
 Wild sunflower.
 False esparcet.

Respectfully submitted,
 GEO. H. GLOVER,
 Veterinarian.

REPORT OF THE ARKANSAS VALLEY FIELD AGENT

To The Director:

I desire to submit the following report as an outline of the work of the Field Agent for the season of 1905.

The work of the Field Agent has been largely co-operative in nature with field observations and some small plat work on the Experiment Station property.

Investigations have been made on the following topics:

CANTALoupES.

1. Development by seed selection of a cantaloupe to resist the rust injuries, has been made, resulting in encouraging progress.

Seed selected from hills showing this tendency were planted on a plat subject to rust conditions, and the results revealed the value of such a line of selection. Seed from many individual melons from this plat have been saved to carry this investigation to a more complete success. Extensive field observations on this line of investigation were also made. The relative merits of the strain of seed in which this resistant tendency was discovered, and the marked results from the seed selection for this object during the past two years, seem to warrant the publication of the information thus gained. Accordingly a more extended review of this investigation has been made in bulletin 104.

2. The problem of improvement in quality by seed selection, has also been given attention, and advance in this work is shown in the results of each succeeding year.

3. Testing of hot beds for starting early cantaloupes has been under investigation for several years, in co-operation with several growers but the results do not warrant the practise to any extent of such a plan.

4. The control of the melon louse has been a field study in co-operation with growers and the Department of Entomology, during the past season. An experiment was tried on several farms, in which carbon bi-sulphide was used to destroy the lice; the infested hills were covered with a common tub, and a small piece of sponge or cotton saturated with carbon bi-sulphide, was placed on a stick under the tub, and after drawing a little earth around the outside of the tub to prevent the escape of the poisonous gas, the hill was left for a time to kill the lice. The results were only a partial success in destroying the lice, as when the gas was strong

enough to kill all the lice, it also killed the vines. And when used weak enough to prevent injury to the plant, the lice were not all destroyed, many under the leaves escaping. Varying amounts of poison, and different lengths of time were tried, but with no satisfactory results. The lice seem to harbor under hedge rows and brush over winter, so that clean field conditions and a careful attention to detect and destroy the lice on their appearance, seem to be the only means of control which have been thus far determined for our conditions in Colorado.

BEETS.

1. A similar line of investigation to develop a beet which will be resistant to disease, has been instituted, but owing to the fact that it takes two years to grow beet seed, and that some seasons the disease does not appear, the advance in this investigation is slow.

The past season a small plat of beets were grown from seed produced from a beet that, in 1903, seemed to withstand the attacks of the "Curly Top." The plat produced a very fine uniform lot of beets which have been siloed for future use as mother beets.

2. Methods and conditions for successful beet seed production have been studied in conjunction with co-operative tests of beet seed growing for Dr. C. O. Townsend of the U. S. Department of Agriculture, who is investigating the single germ seed ball, and other questions of beet culture.

A fine lot of seed was produced from a small plat, not especially planned for seed yield but to test the yielding traits of different types. The results of this and other tests of previous years, seem to indicate that a profitable beet seed crop could be grown in Colorado, if attention were paid to the selection of special seed yielding types, and the freedom of the mother beets from disease. Also that the attacks of the false chinch bug can be avoided if mother beets are set in clean soil conditions and are not surrounded by a harbor of weeds or other crops on which the insects thrive. It has been observed that mother beets which were surrounded by grain, were not injured by insects of any kind.

ALFALFA.

A line of investigation regarding the improvement of alfalfa by seed selection has been instituted. A small nursery of about a thousand individual plants were started the past season. The variation of different plants promises a good foundation to work on.

Seed was selected from a large number of individual plants for future planting to carry on the work; also a study of the methods employed and the conditions which now affect the production of alfalfa seed, was made.

There are conditions which seriously affect the production of alfalfa seed. Under direction and in co-operation with Prof. C. P. Gillette, the insects which work injury to alfalfa, as well as those which work injury to other crops have been studied.

Some interesting advance was made in a plan to control the grasshopper in the alfalfa fields by the use of a hopper dozer; a detailed report of this has already been submitted.

CORN.

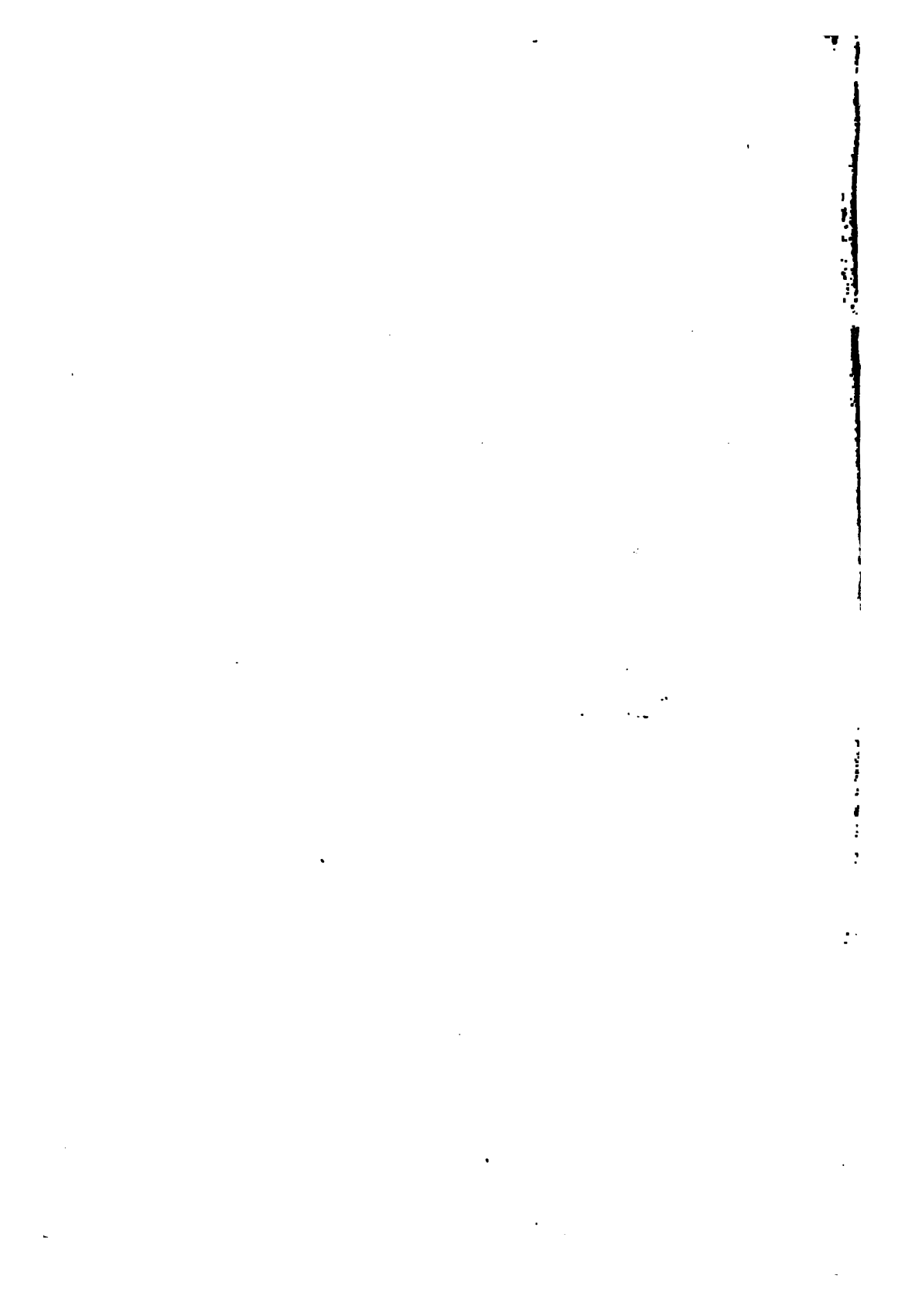
About an acre of corn was planted with fourteen varieties for a comparative test. This work was carried on for Prof. C. P. Hartley of the U. S. Department of Agriculture.

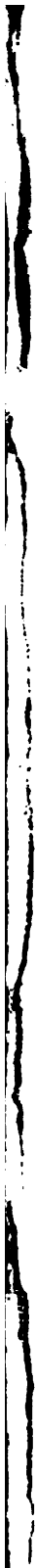
The attacks of the corn worm completely destroyed the crop.

The above, with the Mereological observations which have been kept, constitutes an outline of the work of the past season.

Respectfully submitted,

PHILO K. BLINN.





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